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# Nuytsia

WESTERN AUSTRALIAN HERBARIUM  
VOLUME 20 2010



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*Nuytsia floribunda* (Labill.) R.Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the 'Gulde Zeepaard' on one of the first explorations along the south coast of Australia.

Photograph: A.S George

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# CONTENTS

Main papers	Page
Typification of <i>Gnaphalium collinum</i> var. <i>monocephalum</i> (Gnaphalieae: Asteraceae) and clarification of related material. C. Flann, P.G. Wilson and J.J. Wierenga	1
Molecular markers provide an independent test of species boundaries in the two morphologically similar species <i>Desmocladus flexuosus</i> and <i>D. asper</i> (Restionaceae). E.A. Sinclair and R.L. Barrett	7
A new locally endemic species of <i>Acrotriche</i> (Ericaceae: Styphelioideae: Styphelieae) from the Ravensthorpe area. M. Hislop	19
<i>Melaleuca</i> (Myrtaceae) of Western Australia: five new species, three new combinations, one new name and a new state record. L.A. Craven, B.J. Lepschi and K.J. Cowley	27
A revision of the <i>Micromyrtus racemosa</i> complex (Myrtaceae: Chamelaucieae) of south-western Australia. B.L. Rye	37
A revision of <i>Calothamnus quadrifidus</i> (Myrtaceae). A.S. George and N. Gibson	57
<i>Stylidium</i> miscellany 1: typifications and new taxa from south-west Western Australia. J.A. Wege	79
An account of <i>Eutaxia</i> (Leguminosae: Mirbelieae) with a focus on the Western Australian species. C.F. Wilkins, J.A. Chappill and G.R. Henderson	109
Two new, glaucous-leaved species of <i>Isopogon</i> (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia. M. Hislop and B.L. Rye	169
<i>Calothamnus</i> (Myrtaceae): precursor paper to <i>Flora of Australia</i> . A.S. George	183
A taxonomic revision of the Western Australian endemic species <i>Kennedia coccinea</i> (Fabaceae). T.R. Lally	201
Re-evaluation of <i>Ptilotus polystachyus</i> sens. lat. (Amaranthaceae) and creation of the new combination <i>Ptilotus giganteus</i> . R.W. Davis and R. Butcher	217
<i>Enekbatus</i> , a new Western Australian genus of Myrtaceae with a multi-locular indehiscent fruit. M.E. Trudgen and B.L. Rye	229

## CONTENTS (*continued*)

The status of infraspecific taxa and new subspecies in <i>Ptilotus stirlingii</i> (Amaranthaceae). R.W. Davis and R. Butcher	261
<i>Logania sylvicola</i> (Loganiaceae), a new species from south-west Western Australia. R.J. Cranfield, M. Hislop and T.D. Macfarlane	271
<i>Darwinia hortiorum</i> (Myrtaceae: Chamelaucieae), a new species from the Darling Range, Western Australia. K.R. Thiele	277
Myxomycota census of Western Australia. K.J. Knight and M.H. Brims	283
Two new taxa of <i>Verticordia</i> (Myrtaceae: Chamelaucieae) from south-western Australia. A.S. George and M.D. Barrett	309
<b>Short Communications</b>	
<i>Tetratheca</i> sp. Mt Solus (F. Obbens 307/98) (Elaeocarpaceae) is not distinct from <i>Tetratheca affinis</i> . R. Butcher	319
A nomenclatural correction in <i>Verreauxia</i> (Goodeniaceae). A.S. George	321
A lectotype and new combination in <i>Hypocalymma</i> (Myrtaceae: Chamelaucieae). B.L. Rye	323
<b>Other contents</b>	
Referees for Volume 20	327
Corrections to <i>Nuytsia</i> Volume 19(2)	327
Conservation Codes for Western Australian Flora	328
Publication date for <i>Nuytsia</i> Volume 19(2)	328
Notes for Authors	329



## Typification of *Gnaphalium collinum* var. *monocephalum* (Gnaphalieae: Asteraceae) and clarification of related material

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### Abstract

Flann, C., Wilson, P.G. & Wieringa, J.J. Typification of *Gnaphalium collinum* var. *monocephalum* (Gnaphalieae: Asteraceae) and clarification of related material. *Nuytsia* 20: 1–5 (2010). The protologue of *Gnaphalium collinum* var. *monocephalum* Hook.f. cites three gatherings which are now considered to be referable to three different taxa known by the names *Euchiton lateralis* (C.J.Webb) Breitw. & J.M.Ward, *Euchiton traversii* (Hook.f.) Holub and *Argyrotegium mackayi* (Buchanan) J.M.Ward & Breitw. This has caused confusion regarding the typification and application of J.D.Hooker's varietal name. This article resolves the uncertainty and provides a corrected synonymy for all the taxa involved.

### Introduction

Recent taxonomic work in the genus *Euchiton* Cass. (Flann *et al.* 2008) has raised questions about the name *Gnaphalium collinum* var. *monocephalum* Hook.f. (1859) as there has been confusion regarding its application resulting from issues of typification (Drury 1972, Ward *et al.* 2003). The protologue included three gatherings which are now referred to three different taxa known as *Euchiton lateralis* (C.J.Webb) Breitw. & J.M.Ward, *Euchiton traversii* (Hook.f.) Holub and *Argyrotegium mackayi* (Buchanan) J.M.Ward & Breitw. Two of the gatherings of *G. collinum* var. *monocephalum* were cited by Benth in the protologue of *Gnaphalium collinum* var. *radicans* Benth. (1867) which complicated the situation. Lectotypes have been designated for both of the latter names (Wakefield 1957, Drury 1972) but these have not been widely adopted (Ward *et al.* 2003). This issue is now resolved and in line with the recent revision of the taxonomy of this group (Flann *et al.* 2008) a revised set of synonymies is listed

### Discussion

Hooker (1859) in the protologue of *Gnaphalium collinum* var. *monocephalum* referred explicitly to one gathering as 'HAB: Western Mountains, Archer', and in the discussion to two Mueller gatherings from the 'Australian Alps at elevations of 5-6000 ft' each of which bore one of two designations



of Mueller's (*G. involucreatum* var. *radicans* or *G. involucreatum* var. *monocephalum*). The original material therefore consists of the specimens of these three cited gatherings actually used by Hooker together with any unseen duplicate specimens, each specimen being a syntype.

The sheet K324334/5 contains two syntype specimens of *G. collinum* var. *monocephalum*. One of these is enclosed in an envelope labelled 'Western Mountains, Archer' (Figure 1A, C inset). This material is now known as *Euchiton lateralis*. The other syntype (Figure 1A), labelled in Mueller's hand as *Gnaphalium involucreatum* var. *radicans* and as coming from 'Summits of the Munyang Mountains 5-6000', on springs' is assumed to consist of at least the element immediately above the label and probably one or more of the other four elements attached to the sheet. Previous labelling and pencilled lines suggest all may not belong to the one gathering. However, all five elements are of the species now known as *Argyrotegium mackayi*.

There is a further syntype of *G. collinum* var. *monocephalum* at K under the other Mueller herbarium name, '*G. involucreatum* var. *monocephalum*', with a similar label in Mueller's handwriting but with the collection locality 'Subalpine pastures on the Snowy River' (K324224, Figure 1B). This material is now known as *Euchiton traversii* and is also a syntype of that name for when Hooker (1864: 154) described

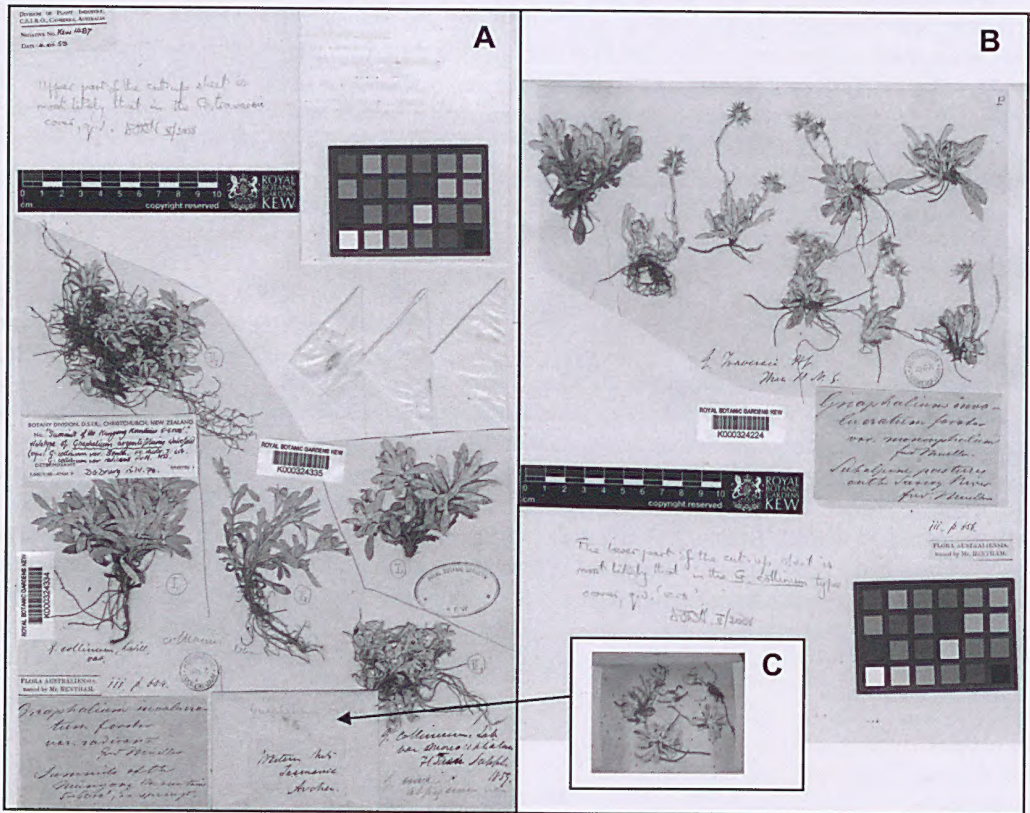


Figure 1. Type material of *Gnaphalium collinum* var. *monocephalum* A – herbarium sheet with both the Mueller and Archer syntype material (K324335/ K324334 ), the envelope contains the lectotype of *G. collinum* var. *monocephalum* and the visible specimens are an isolectotype of *G. collinum* var. *radicans*. B – Syntype of *G. collinum* var. *monocephalum* and *G. traversii* (K324224). C – Insert showing the Western Mountains, Tasmania, Archer material (contents of envelope on K324335), lectotype of *G. collinum* var. *monocephalum*.



*G. traversii* he noted 'Mueller has sent this same plant from the Victorian alps as *G. involucreatum* var. *monocephalum*, but besides the totally different habit it differs from that plant in the heads not being bracteate and twice as large, and in the looser cottony tomentum'.

Bentham (1867: 654) described *Gnaphalium collinum* var. *radicans* and recognised it as being distinct from both *G. collinum* var. *monocephalum* and *G. traversii* citing 'Victoria. Summits of the Australian Alps, F. Mueller.' and 'Tasmania. Western mountains, Archer.' Bentham had received Mueller's material on loan for work on *Flora Australiensis* and so he had available both the material on K324334/5 referred to above and the two sheets at MEL that bear a label annotated '*G. involucreatum* var. *radicans*' in Mueller's handwriting namely MEL49311 and MEL49312. Wakefield (1957: 187, 188) published *Gnaphalium argentifolium* N.A. Wakef. as a *nom. et. stat. nov.* based on *G. collinum* var. *radicans*, stating:

'LECTOTYPE: "Summits of the Australian Alps", leg. F. Mueller. This material—seen by Bentham and now in MEL—appears to be part of a suite of specimens, now in various herbarium folders, collected under the original label: In pratis altioribus montium Munyang Mountains, utplurimum altitudinem 5-6000 ft. Jan. '55. Dr. Ferd. Mueller.'

Clearly Wakefield has designated the specimen on MEL49311 as the lectotype as the locality information given on the label attached to that sheet is as cited by Wakefield and as given by Bentham in the protologue. *Gnaphalium argentifolium* was transferred by Anderberg (1991: 167) to the genus *Euchiton* Cass. as *Euchiton argentifolius* (N.A. Wakef.) Anderb., and is now referred to *Argyrotegium* as *A. mackayi* (Flann *et al.* 2008), making *G. collinum* var. *radicans*, *G. argentifolium* and *E. argentifolius* all nomenclatural synonyms.

Drury (1972) in his paper on the genus *Gnaphalium* discussed *G. collinum* var. *monocephalum* under the heading 'monocephalous chamaephytes of group IV'. He did not discuss lectotypification in the text but in a small note in a table comparing several species (Drury 1972: 172) he clearly lectotypified *G. collinum* var. *monocephalum* on the 'Archer, Western Mountains' material at K. The data given for *G. collinum* var. *monocephalum* can be traced back to the page authored by Drury and attached to K324334/5. The plants in the envelope are the only ones on the sheet with one capitulum. They are small, white-hairy, stoloniferous, and have rosettes with a single capitulum that contains fewer than 80 female florets. However, it is clear that Drury's measurements relate to the visible specimens on the sheet which are Mueller's collection of *G. involucreatum* var. *radicans* from the Munyang Mountains that is now known as *A. mackayi*, rather than the Archer material enclosed in the envelope, that is now known as *E. lateralis*. The latter species was thought to be endemic to New Zealand but has now been shown to be present in Tasmania (Flann *et al.* 2008).

Drury's lectotype fits the description and as a cited specimen it cannot be considered to be in major conflict with the protologue, therefore his choice cannot be superseded (Art. 9.17b, McNeill *et al.* 2006), moreover, it is in conformity with current nomenclature. If he had correctly written down what he evidently tried to do, i.e. lectotypify the name on the mounted specimens on that sheet, we would now have been forced to supersede his choice because it would have been in conflict with the protologue.

The practical outcome is that the correct placement for two names can now be clearly stated: *G. collinum* var. *monocephalum* is a heterotypic synonym of *E. lateralis* while *G. collinum* var. *radicans* (and therefore also *G. argentifolium*) is a heterotypic synonym of *A. mackayi*.



### Revised synonymy of associated species

***Euchiton*** Cass. in *Dict. Sci. Nat.*, ed. 2. 56: 214 (1828). = *Gnaphalium* sect. *Euchiton* (Cass.) DC., *Prodr.* 6: 235 (1838). – Type: *Euchiton pulchellus* Cass. = *Euchiton involucratus* (G.Forst.) Holub.

***Euchiton lateralis*** (C.J.Webb) Breiwt. & J.M.Ward in Ward & Breitwiser, *New Zealand J. Bot.* 36(2): 303 (1998). = *Gnaphalium laterale* C.J. Webb, *New Zealand J. Bot.* 26(3): 485–487. 1988 – *Holo*: [New Zealand] Ahukawakawa Swamp, Egmont National Park, 3000 ft, Jan. 1963, A.P. Druce (CHR158660!) = *Gnaphalium collinum* var. *monocephalum* Hook.f. in J.D. Hooker, *Bot. Antarct. Voy. III. (Fl. Tasman.)*. 2: 364 (1859). = *Gnaphalium japonicum* var. *monocephalum* (Hook.f.) F.Muell., *Pap. & Proc. Roy. Soc. Tasmania* for 1870: 15 (1871). – *Lecto*: (designated by Drury 1972: 172): [Australia] Western Mountains, Tasmania, *Archer* (K!).

***Euchiton traversii*** (Hook.f.) Holub, *Folia Geobot. Phytotax.* 9: 271 (1974). = *Gnaphalium traversii* Hook.f., *Handb. N. Zeal. Fl.* 154 (1864). – *Syntypes*: [Middle Island:] [New Zealand] Wairau mountains, alt. 3–4000 ft., *Travers* (K!); [New Zealand] alps of Canterbury, *Haast*; [Australia] Subalpine pastures on the Snowy River, *F. Mueller* (K324224!).

***Argyrotegium*** J.M.Ward & Breiwt. in J.M.Ward, I. Breitwiser & C. Flann, *New Zealand J. Bot.* 41: 608–609 (2003). – Type: *Argyrotegium mackayi* (Buchanan) J.M.Ward & Breiwt.

***Argyrotegium mackayi*** (Buchanan) J.M.Ward & Breiwt. in *New Zealand J. Bot.* 41: 609 (2003). = *Raoulia mackayi* Buchanan, *Trans. & Proc. New Zealand Inst.* 14: 354–355, t. 34, f.2. (1882). = *Gnaphalium traversii* var. *mackayi* (Buchanan) Kirk, *Stud. Fl. New Zealand*: 299 (1899). = *Gnaphalium mackayi* (Buchanan) Cockayne, *Veg. New Zealand*, ed. 2: 324, 439 (1928). = *Euchiton mackayi* (Buchanan) Anderb., *Opera Bot.* 104: 167 (1991). – *Syntype*: [New Zealand] Black Peak Range, South Island, *McKay* (K!) = *Gnaphalium collinum* var. *radicans* Benth. in *Fl. Austral.* 3: 654 (1867). = *Gnaphalium japonicum* var. *radicans* (Benth.) Maiden, *Agric. Gaz. New South Wales* 10: 1024 (1899). = *Gnaphalium argentifolium* N.A. Wakef., *Vict. Naturalist* 73(11): 187 (1957). = *Euchiton argentifolius* (N.A. Wakef.) Anderb., *Opera Bot.* 104: 167 (1991). – *Lecto*: (designated by Wakefield, 187: (1957): [Australia] Summits of the Australian Alps, *F. Mueller* (MEL49312!).

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## Molecular markers provide an independent test of species boundaries in the two morphologically similar species *Desmocladus flexuosus* and *D. asper* (Restionaceae)

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### Abstract

Sinclair, E.A. & Barrett, R.L. Molecular markers provide an independent test of species boundaries in the two morphologically similar species *Desmocladus flexuosus* and *D. asper* (Restionaceae). *Nuytsia* 20: 7–17 (2010). *Desmocladus flexuosus* exhibits extensive morphological variation across its geographic range, and even within the Perth metropolitan area. It may be potentially confused with its congener, *D. asper*, across this region where the two are sympatric. Here we use molecular markers to show that these two species are genetically distinct, and describe several morphological characters that can aid identification in the field.

### Introduction

Restionaceae are a large clade of grass-like or sedge-like rushes, containing approximately 490 described species (Linder *et al.* 1998). A combination of few morphological characters and significant variation in intraspecific growth form (depending on age of the plant and environmental conditions) make it difficult to differentiate between some species in the field, particularly in the absence of flower spikelets.

Genus level phylogenies for the Restionaceae, including Australian members, have been published based on morphological (Linder *et al.* 2000) and molecular data (Briggs *et al.* 2000, Linder *et al.* 2003; Hardy and Linder 2005). However, for Australian taxa relationships below the level of genus have not been examined in any detail with molecular tools.

*Desmocladus flexuosus* (R.Br.) B.G. Briggs & L.A.S. Johnson is widespread in the coastal regions of Western Australia between Kalbarri and Israelite Bay, and is broadly sympatric with *D. asper* (Nees) B.G. Briggs & L.A.S. Johnson across large parts of that region, including the Perth metropolitan area (Figure 1). Plants are dioecious, with individual rhizomes giving rise to many branching culms up to 30–40 cm in height. *Desmocladus flexuosus* is similar morphologically to *D. virgatus* and *D. austrinus*, though their tufted habit makes them readily recognisable, especially in the field (Briggs and Johnson 2001). These two species are absent from the Perth area, making *D. flexuosus* and *D. asper* the closest

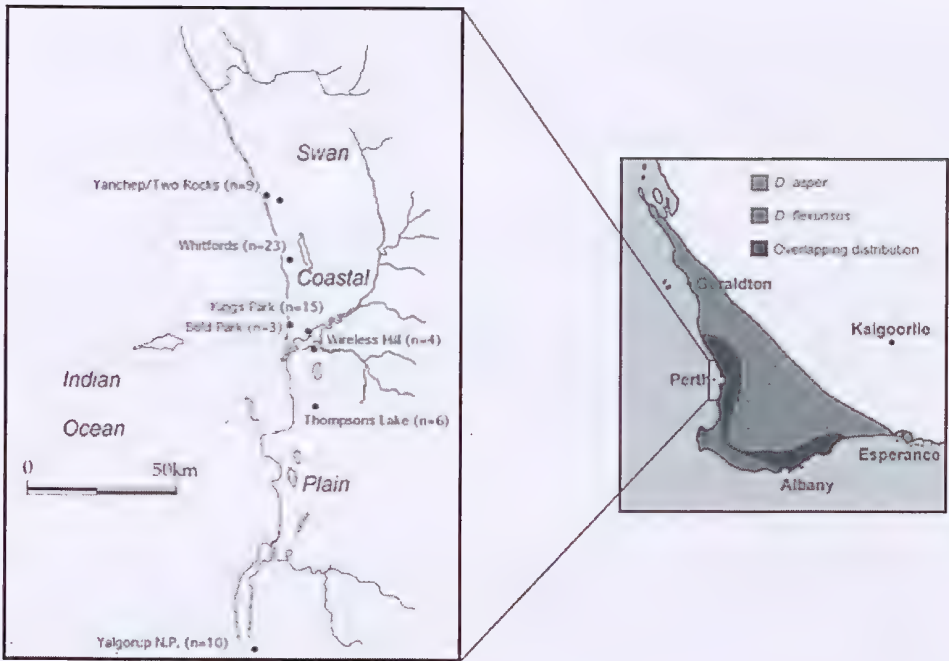


Figure 1. Map showing the distributions of *D. asper* and *D. flexuosus* in Western Australia (modified from *Florabase*: <http://florabase.dec.wa.gov.au/>). Note the significant area of overlap between the two species. Enlargement shows the sampling locations for *Desmocladus* spp. Sample sizes are given in parentheses.

relatives in this region. *Desmocladus asper* can be distinguished by its rough-tuberculate culms and sessile male spikelets. However, *D. flexuosus* and *D. asper* are difficult to differentiate when sterile. While neither species is listed as threatened, they are important species in the stabilization of soils, and may be required in bushland restoration projects. Here, we generate genetic markers and collect morphological measurements to (1) determine whether *D. flexuosus* and *D. asper* can be differentiated using genetic markers, and (2) assess morphological characters that may allow accurate identification of sterile specimens in the field.

## Materials and Methods

### Sampling

Fresh whole culms were sampled for genetic analysis using Amplified Fragment Length Polymorphic loci (AFLPs). The location of samples was recorded by GPS. Culms were collected between July and November 2004 with sample sizes as follows: Bold Park (n=3), Yanchep National Park/Two Rocks (n=9), Whitfords (n=23), Wireless Hill (n=4), Kings Park (n=15), Yalgorup National Park (n=10), and Thompsons Lake (n=6) (Figure 1). Culms were collected at a minimum distance of 5 m to avoid sampling the same plant. Vouchers for all reference material are deposited in the Kings Park and Botanic Gardens (KPBG) Herbarium.

## Molecular methods

Genomic DNA was extracted using the plant Qiagen kit (Qiagen Inc.). Extractions were performed on material from a single culm, with approximately 0.2–0.4 g plant material ground in liquid nitrogen prior to extraction. AFLPs are dominant multilocus markers (Vos *et al.* 1995). AFLP fingerprint profiles were generated for each sample. The restriction enzymes used were *Eco*RI and *Mse*I. Primer sequences for preselective PCR were (5' to 3') GACTGCGTACCAATTCA and GATGAGTCCTGAGTAAC. An additional two bases were added to the 3' end for selective PCR primers. We used three sets of primers: m-CTT/e-act (6-Fam label), m-CTT/e-agg (Vic label), and m-CTT/e-acc (Ned label) (Table 1). Standard protocols were followed, as described in Zawko *et al.* (2001). Bands were visualized using an ABI 377 sequencer and GENESCAN software (Applied Biosystems) with internal size standard (GS-500 ROX; Applied Biosystems). We imported GENESCAN files into Genotyper (Applied Biosystems) and each DNA profile was scored for the presence (1) or absence (0) of bands between 100 and 450 base pairs. The reproducibility of bands was assessed using five samples, each with two separate DNA extractions. A Principal Coordinates Analysis (PCA) was performed using GenAlEx v5 (Peakall & Smouse 2001) to show the relative similarities of individuals. An Analysis of Molecular Variance (AMOVA; Excoffier *et al.* 1992) was performed with the GenAlEx program to determine the proportion of variation attributed within and between each species.

## Morphological Methods

Culm morphology was examined using a light microscope. Hair type and culm texture were described following the terminology of McCusker (1999). Specific characters examined in detail were culm indumentum, culm texture, primary culm length and width, and bract dimensions (Figures 4C, 5E). These characters were chosen, as they are available in the field regardless of season or sex of the clone being examined. Measurements of culm internode length and width and bract length and width were made from five to six internode sections for each sample. These measures were plotted in two dimensional plots. Means and standard deviation were determined for each character. Representative material of differing age and ecotypes is required to fully document the variation in several of these characters, particularly indumentum.

## Results

### Molecular

222 AFLP bands were scored for a total of 69 samples of *Desmodium*<sup>a</sup> from seven locations for three primer pairs (Table 1). The PCA showed two distinct clusters of samples, representing the two morphologically similar species, *D. flexuosus* and *D. asper* (Figure 2). Cluster 1 (n=43; on the left) is *D. flexuosus* and Cluster 2 (n=26; on the right) is *D. asper*. The bands were highly polymorphic within both species (Table 1). Unique haplotypes (or DNA profiles) were identified for all samples. Analysis of molecular variance (AMOVA) showed that most of the genetic variation was attributed to within (90.0% and 94.0%) relative to among populations (10.0% and 6.0%, *D. flexuosus* and *D. asper* respectively).



**Table 1.** Summary of genetic variation by species

Primer pairs	<i>D. flexuosus</i> (n=43)			<i>D. asper</i> (n=26)		
	No. bands	Poly.	%poly	No. bands	Poly.	%poly
		bands	bands		bands	bands
m-CTT/e-agg	39	36	92.3	50	49	98.0
m-CTT/e-acc	53	50	94.3	64	64	100.0
m-CTT/e-act	71	68	95.8	71	68	95.8
Total	163	154	94.5	185	181	97.8

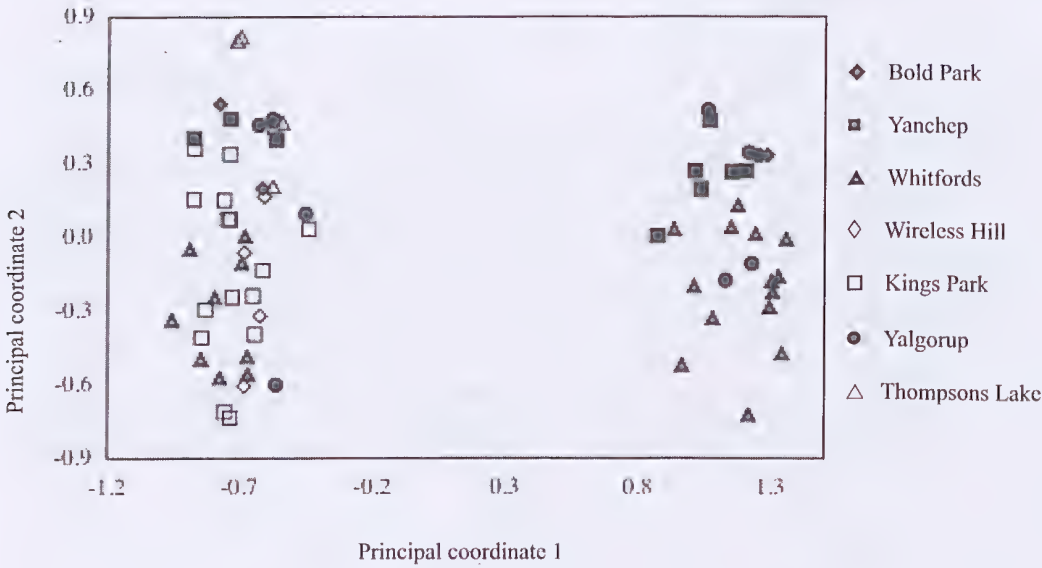


Figure 2. Principal coordinate analysis of *Desmocladius* spp. based on 222 AFLP markers. Left cluster – *D. flexuosus*; right cluster – *D. asper*.

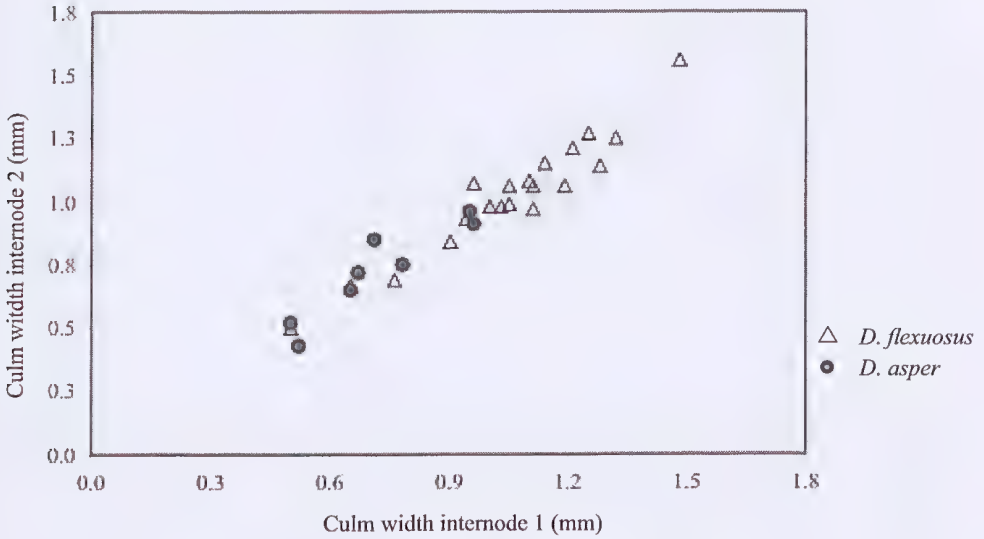


Figure 3. Plot of culm internode width for *Desmocladius asper* and *D. flexuosus*. The width of the basal culm internode is plotted against the width of the second culm internode.

### Morphological

Both species were found to have a high degree of similarity, with considerable overlap in the dimensions of all characters. The range of variation in culm width is shown in Figure 3. Both taxa show partial exclusivity in their dimensions, however, the extremes of both taxa also result in considerable overlap, so that a given individual may be placed in either taxon if its culm width falls in the middle of the range of total variation. This pattern is repeated with culm length and bract dimensions (not shown). Calculation of means and standard deviations for measurements of bracts (Table 2) and culms (Table 3) shows that while the average lengths differ, the differences are not significant. Pate and Meney (1999) considered culm width to be a useful character for separating the two species, describing them as 0.7–1.2 mm wide for *D. asper* and 1.0–3.0 mm wide for *D. flexuosus*. While we found the average culm width to be larger in *D. flexuosus*, it was not significantly so. The one exception is bract width, where the average for *D. asper* is significantly less than *D. flexuosus* (Table 2). Further investigation is required to determine if this difference holds across the entire range for both taxa. The variation observed here represents general plasticity in morphology and cannot be solely attributed to variation across the geographic ranges of either species' due to the restricted sampling range relative to the total range of each species.

Indumentum type and culm texture were the only non-floral features that consistently separated the two taxa. Culm surface texture is best described as crowded-tuberculate in *D. asper*, with little or no space between the low rounded tubercles (Figure 4A, B; 5F), while in *D. flexuosus* it is sparsely tuberculate with the tubercles being more erect and scattered (Figure 5A, B, F). Culms of *D. flexuosus* are also finely striate (Figure 5A), while the culms of *D. asper* are smooth to finely pitted (punctate), becoming increasingly pitted with age. The culm hairs on *D. asper* mostly occur in sparse tufts of spreading to semi-erect hairs (Figure 4B), usually about 0.2–0.3 mm long, while culm hairs on *D. flexuosus* are long-villous, spreading to erect and irregularly twisted (Figure 5D), and (0.5)1.5–2.0(3.0) mm long.

**Table 2.** Mean bract width and length, with standard deviation (SD) for *D. flexuosus* and *D. asper*. Measurements taken from base of plant upwards at successive nodes, on primary culms only.

Culm node	Bract width (mm)						Bract length (mm)						
	1	2	3	4	5	6	1	2	3	4	5	6	
<i>D. flexuosus</i>	Mean	3.30	3.36	3.26	3.18	3.02	2.79	8.86	8.78	8.36	8.16	6.83	6.50
	SD	0.62	0.67	0.66	0.69	0.79	0.62	1.97	1.80	1.71	1.88	1.60	2.10
<i>D. asper</i>	Mean	2.06	2.08	2.05	2.19	1.97	1.95	5.87	5.72	5.88	5.39	5.10	5.31
	SD	0.46	0.32	0.25	0.47	0.20	0.22	1.43	1.78	1.70	0.89	0.89	0.68



**Table 3.** Mean culm internode width and length, with standard deviation (SD) for *D. flexuosus* and *D. asper*. Measurements taken from base of plant upwards at successive internodes, on primary culms only.

Culm node	Culm internode width (mm)					Culm internode length (mm)					
	1	2	3	4	5	1	2	3	4	5	
<i>D. flexuosus</i>	Mean	1.05	1.02	0.98	0.92	0.90	37.36	36.10	33.47	31.38	25.14
	SD	0.23	0.23	0.22	0.20	0.19	10.98	11.12	10.10	10.77	7.85
<i>D. asper</i>	Mean	0.72	0.72	0.70	0.71	0.70	23.14	25.95	28.95	28.39	26.53
	SD	0.17	0.19	0.18	0.16	0.17	5.93	6.46	5.86	3.48	4.41



Figure 4. Morphology of *Desmocladus asper*. A – culm; B – culm with cluster hairs; C – bract; D – female spikelet; E – male spikelets. Voucher: *R.J.Cranfield* 1009/79 (PERTH).



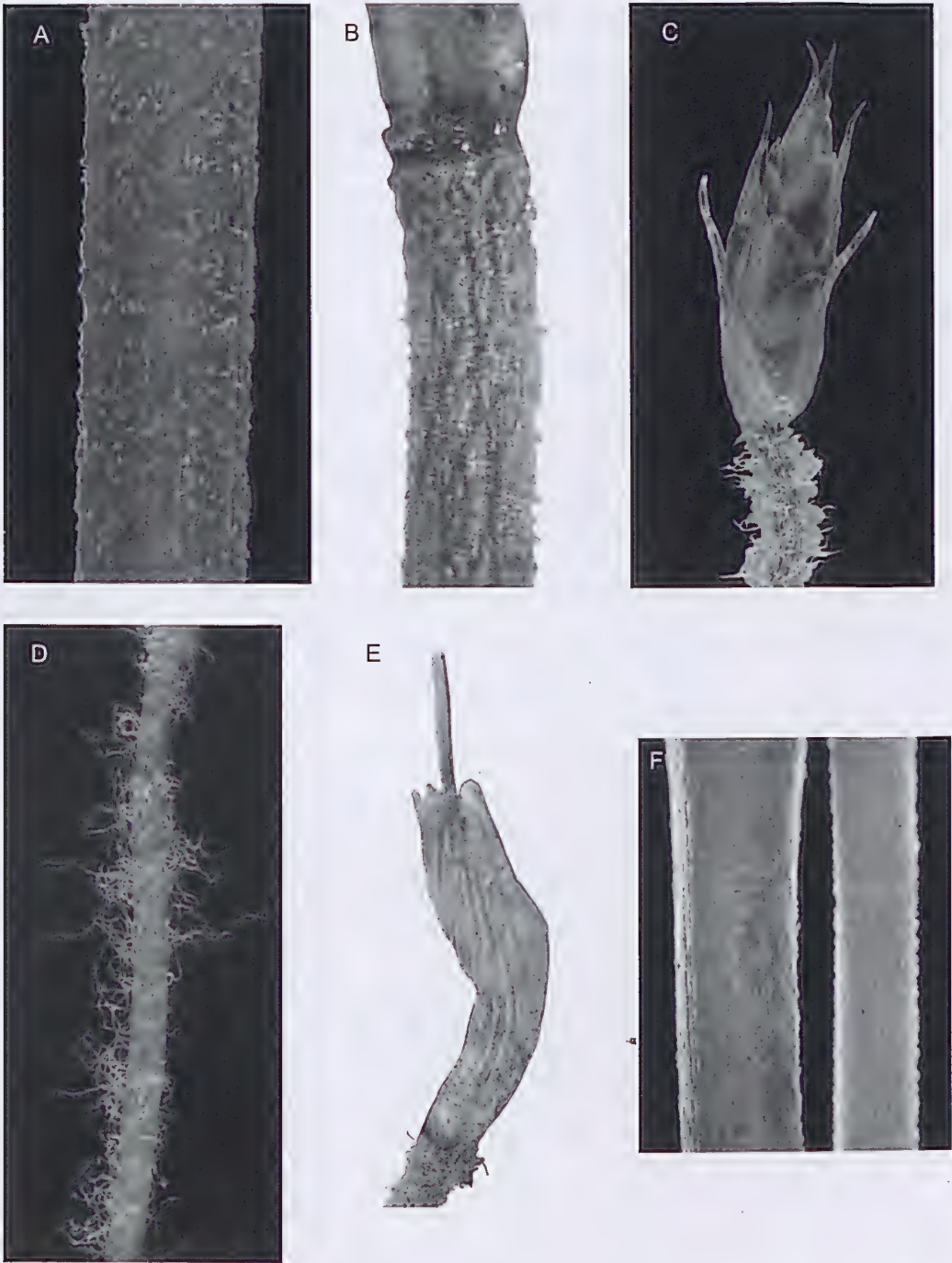


Figure 5. Morphology of *Desmocladius flexuosus*. A – culm showing striations; B – culm showing coarse striations and sparse tubercles; C – male spikelet; D – young culm showing hairs; E – bract; F. – culm of *D. flexuosus* (L) compared to culm of *D. asper* (R). Voucher: *R.D.Royce* 2589 (PERTH) (as above for F(R)).

Discussion

The genetic data showed two distinct clusters of individuals. This was in contrast to the overlapping ranges on morphological measures of culm and bract length and width. *Desmocladus flexuosus* is very similar morphologically to the sympatric *D. asper*. Examination and scoring of the vouchered material, using indumentum type and culm texture, was consistent with the genetic data and confirms their recognition as two distinct species. We are confident that these characters can be consistently scored and provide a good way to differentiate between sterile specimens of the two species in the field. In addition, data provided by B. Briggs (pers. comm. 2006) from a draft treatment of the genus for the *Flora of Australia* provide further characters considered useful in distinguishing *D. asper* from *D. flexuosus* (Table 4).

**Table 4.** Comparison of morphological characters of *D. asper* and *D. flexuosus* (Briggs et al. unpubl.)

Character	<i>D. asper</i>	<i>D. flexuosus</i>
Culm indumentum	Densely villous	Glabrous or villous
Hair length	Short hairs to 0.5 mm long	Hairs 0.5–2 mm long
Culm surface	Culms rough, tuberculate	Culms mostly smooth
Culm origin	Mostly arising from short rhizomes distinctly thicker than the culms (rhizomes connected by slender subterranean stems)	Arising in a tuft or ascending from an elongated subterranean portion
Male spikelets	Mostly in axils of culm sheaths, with 10–21 glumes	At ends of short branches or in axils of culm sheaths, with 4–14 glumes
Female spikelets	3.5–5 mm long	5.5–7.5 mm long

While culm indumentum is a useful character, it is also variable with plant age. In both species, hair density decreases as culms age, and both species can eventually lose all hairs (Figure 5F). The material examined from the Perth region showed a distinct difference in hair type and this difference should be examined across the range of both species. The tuberculate surface of *D. asper* is distinctive in appearance and to the touch, however, the stems of *D. flexuosus* can also be rough and somewhat tuberculate (Figure 5B). In *D. flexuosus*, the tubercles are of a different shape, appearing more peaked, and are scattered on the culms, never forming a uniform covering as in *D. asper*. Culm origin requires examination in the field and was not specifically considered in this study. The position of the male spikelets (Figure 4E) is very useful and was consistent in the specimens examined. There may also be differences in the shape of the female floral bracts (Figs. 4D, 5C), however, this requires further investigation to determine the full range of variation across the species.

*Desmocladus flexuosus* and *D. asper* can be readily identified by their AFLP profiles in the laboratory. It is concluded that AFLP data and morphology are congruent in indicating that *D. asper* and *D. flexuosus* are distinct species, despite considerable variation and overlap in gross morphology.



## Acknowledgements

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## A new locally endemic species of *Acrotriche* (Ericaceae: Styphelioideae: Stypheliaceae) from the Ravensthorpe area

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### Abstract

Hislop, M. A new locally endemic species of *Acrotriche* (Ericaceae: Styphelioideae: Stypheliaceae) from the Ravensthorpe area. *Nuytsia* 20: 19–25 (2010). A new and apparently rare species of *Acrotriche* R.Br., *A. orbicularis* Hislop, is described, illustrated and its distribution mapped. For purposes of comparison, the species with which it is most likely to be confused, *Acrotriche cordata* (Labill.) R.Br., is also illustrated and mapped. An updated key to the *Acrotriche* species of Western Australia is provided.

### Introduction

The Ravensthorpe Range extends approximately 50 km on a northwest-southeast axis to the north and east of the small, south-coast town of Ravensthorpe. It has long been known for its complex geology, and in recent decades it has become increasingly clear through a series of biological surveys (Chapman & Newbey 1995; Kern *et al.* 2008), that it is also an area of high biodiversity. In their analysis of phytogeographic patterns within the Southwestern Australian Floristic Region, Hopper & Gioia (2004) identified the area as one of exceptional species richness, with a correspondingly high level of endemism. Craig (Harris *et al.* 2008) lists over 50 endemics or near endemics for the range. This number is growing steadily as ongoing taxonomic research, based on an expanding specimen base, continues to identify new and often geographically restricted taxa. Of these endemics, six (including the species described below) are restricted to the relatively isolated Bandalup Hill and immediate vicinity.

Significant deposits of several economically important minerals are present in the Ravensthorpe Range, and the area has a long history of mining, dating back to the last years of the nineteenth century. Within the last decade a major new nickel mine commenced operation at Bandalup Hill. Although that project is currently in abeyance, the continued high demand for other minerals, such as gold and copper, is likely to give rise to new mining proposals for the area. Much of the recent flora survey work has been undertaken either directly for mining companies, or by the Department of Environment and Conservation (DEC), as it seeks to more fully assess the conservation values of the range in anticipation of future mining applications.



During survey work associated with one such study (Kern *et al.* 2008), a problematic collection of a species of *Acrotriche* R.Br. was made at Bandalup Hill and later referred to the author. The specimen was similar in leaf shape to a broad-leaved variant of the widespread and variable *Acrotriche cordata*, but with an anomalous, pruinose texture. However the material was in early bud and its true status could not be ascertained before the completion of that project. In their report therefore, the authors referred to the plant informally as *Acrotriche* aff. *cordata* (S. Kern & R. Jasper LCH 16953) and highlighted it as being of potential taxonomic interest under the heading ‘Taxa requiring further study’. The species was finally collected in flower by DEC botanists, R. Butcher and A. Markey, as part of a concerted effort to resolve the status of some of the more problematic taxonomic entities from the range. Examination of the new material, along with Kern & Jasper’s earlier *Acrotriche* collections from Bandalup Hill, revealed that there were significant differences in floral morphology between *Acrotriche* aff. *cordata* and typical *A. cordata*. It also confirmed the view, expressed by the authors in Kern *et al.* (2008), that the new taxon grows with *A. cordata* at this locality. The phrase-name *Acrotriche* sp. Ravensthorpe (S. Kern *et al.* LCH 16953) was subsequently entered on the Census of Western Australian Plants to allow an assessment of its conservation status. The primary purpose of this paper is to formally describe the new species and to update the most recent key (Hislop 2007) to the Western Australian members of the genus.

Methods

This study was based on an examination of dried specimens housed at PERTH. The details of the methods used to measure plant parts and make other morphological observations are the same as those described in an earlier paper on the genus *Acrotriche* (Hislop 2007).

The distribution map was compiled using DIVA-GIS Version 5.2.0.2 and based on PERTH specimen data.

Key to the Western Australian species of *Acrotriche* (modified from Hislop 2007)

- 1. Corolla white, hairs evenly distributed across the lobes and into the throat of the tube  
(Borden–Wellstead–Ongerup areas).....**A. dura**
- 1: Corolla predominantly greenish, occasionally yellowish-green or greenish suffused purple,  
lobes usually with hairs confined to subapical tufts, occasionally with very sparse,  
long hairs scattered across the surface, the tube with 5 hair tufts in the throat
- 2. Leaf apex sharply mucronate
- 3. Leaves with recurved margins; sepals *c.* 2 mm long; corolla lobes at least 2 mm long  
(Stirling Range to the Ravensthorpe area and between Cape le Grand and Israelite Bay) ..**A. ramiflora**
- 3: Leaves slightly concave, flat or slightly convex; sepals to 1.7 mm long; corolla lobes  
to 1.3 mm long
- 4. Leaves ovate, occasionally narrowly ovate, 3–6 mm wide, most or at least some  
with cordate bases, veins 5–7(–9+),  $\pm$  equally distinct, midrib to 0.1 mm wide;  
corolla throat hairs issuing directly from unmodified epidermal cells; endocarp with  
prominent longitudinal ribs (coastal and subcoastal areas of the SE between  
Toolinna Cove and the South Australian border)..... **A. patula**
- 4: Leaves narrowly ovate, 1.7–3.2 mm wide, base rounded but never cordate,  
veins 3–5 (usually 3) with the midrib prominent and usually produced into a  
distal abaxial keel, midrib 0.2–0.3 mm wide; corolla throat hairs issuing from

- 5 raised cushion-like outgrowths; endocarp smooth (the central south-west, between the Kondinin area in the west and the Bremer Range in the east, and between Great Eastern Highway in the north and the Lake King area)..... ***A. lancifolia***
- 2: Leaf apex usually obtuse or subacute, very occasionally acute, but then with an innocuous tip, never sharply mucronate
- 5: Corolla lobe hairs largely confined to a subapical tuft, the latter arranged in a crescent-shaped formation; ovary 7–10-locular (Stirling Range to the Ravensthorpe area with an outlier W of Lake Grace)..... ***A. parviflora***
- 5: Corolla lobe hairs either mostly in a subapical tuft or not, but if so then the tuft  $\pm$  straight transverse band; ovary 4–5-locular
- 6: Leaves pruinose, broadly ovate to depressed-ovate, broadly elliptic to transversely elliptic or occasionally broadly obovate to depressed-obovate; corolla lobes 0.6–0.7 mm long, with rather sparse hairs scattered across the surfaces; corolla throat hairs issuing from unmodified epidermal cells (Ravensthorpe area) ..... ***A. orbicularis***
- 6: Leaves not pruinose, variable in shape, whether ovate, elliptic or obovate, rarely broadly so; corolla lobes 1.2–1.9 mm long, with hairs in a well-defined subapical tuft (occasionally a very few hairs may be present below the tuft); corolla throat hairs dense, issuing from 5 raised, cushion-like outgrowths (frequently coastal but sometimes extending well inland in areas adjacent to the south coast, from the central west coast near Lceman southwards along the west and south coasts to the Great Australian Bight)..... ***A. cordata***

### Taxonomy

***Acrotriche orbicularis* Hislop, *sp. nov.***

*A. cordatae* affinis sed foliis pruinosis, et lobis corollae sparse et irregulariter pilosis, non pilis in serialibus-transversalibus manifestis differt.

*Typus:* East of Ravensthorpe [precise locality withheld for conservation reasons], Western Australia, 18 September 2008, *R. Butcher & A. Markey* RB 1306 (*holo:* PERTH 08023352; *iso:* CANB, NSW).

*Acrotriche* sp. Ravensthorpe (S. Kern et al. LCH 16953), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed October 2009].

Compact, spreading *shrubs* to c. 60 cm high and 80 cm wide. Young *branchlets* with a moderately dense indumentum of straight or  $\pm$  curved, patent to distinctly retrorse hairs, 0.08–0.10 mm long, persistent in patches on the older wood for several seasons. *Leaves* spirally arranged, usually shallowly to steeply antrorse, occasionally  $\pm$  patent, either broadly ovate to depressed-ovate, broadly elliptic to transversely elliptic or occasionally broadly obovate to depressed-obovate, 4.8–8.2 mm long, 3.8–8.0 mm wide; apex a poorly-defined callus, obtuse; base usually truncate or rounded, less often cuneate or cordate; petiole well-defined, pale yellowish-green or yellow-brown, 0.8–1.3 mm long, with a moderately dense indumentum of retrorse hairs on the adaxial surface; lamina 0.35–0.50 mm thick,  $\pm$  straight or gently recurved along the longitudinal axis, usually adaxially convex, less often  $\pm$  flat; surfaces glabrous, pruinose,  $\pm$  concolorous on young leaves, but usually becoming discolourous through abrasion on old growth, adaxial surface initially matt, becoming shiny on older growth,

venation not evident, abaxial surface paler following abrasion, with 7–9 moderately conspicuous, flat, primary veins, the midrib not differentiated from the others; margins glabrous. *Inflorescence* axillary or issuing from bare nodes below the leaves, erect to spreading; axis 2–4 mm long, with 3–7 flowers terminating in an obscure, bud-like rudiment; axis indumentum of dense, variably orientated hairs 0.2–0.3 mm long; flowers erect and sessile. *Fertile bracts* depressed-ovate to  $\pm$  orbicular, 0.9–1.1 mm long, 1.0–1.1 mm wide, obtuse; abaxial surface with obscure venation, glabrous apart from a zone of short hairs close to the apex; adaxial surface glabrous; margins ciliolate. *Bracteoles* broadly ovate, 0.9–1.2 mm long, 0.7–0.8 mm wide, obtuse, obscurely keeled; abaxial surface hairy about the keel, sometimes sparsely hairy elsewhere, cream- or straw-coloured; adaxial surface glabrous; margins ciliolate. *Sepals* ovate, 1.3–1.5 mm long, 0.9–1.1 mm wide, obtuse; abaxial surface glabrous or with a few hairs towards the apex, cream or greenish-cream becoming scarious towards the margins, the venation obscure; adaxial surface glabrous; margins ciliolate with hairs 0.08–0.12 mm long. *Corolla tube* green, cylindrical, much longer than the sepals (by up to 1.6 mm), 1.9–2.5 mm long, 0.9–1.0 mm wide, the outer surface glabrous, the inner with 5 rather sparse tufts of hair below the lobes, these issuing from unmodified epidermal cells, glabrous below. *Corolla lobes* green, much shorter than the tube (ratio = 0.3–0.4: 1), widely spreading, 0.6–0.9 mm long, 0.5–0.6 mm wide at base, glabrous externally, the inner surface sparsely and irregularly hairy (the hairs to 0.5 mm long) and faintly papillose. *Anthers* partially exserted from the tube at anthesis, 0.4–0.5 mm long; *filaments* terete, 0.2–0.3 mm

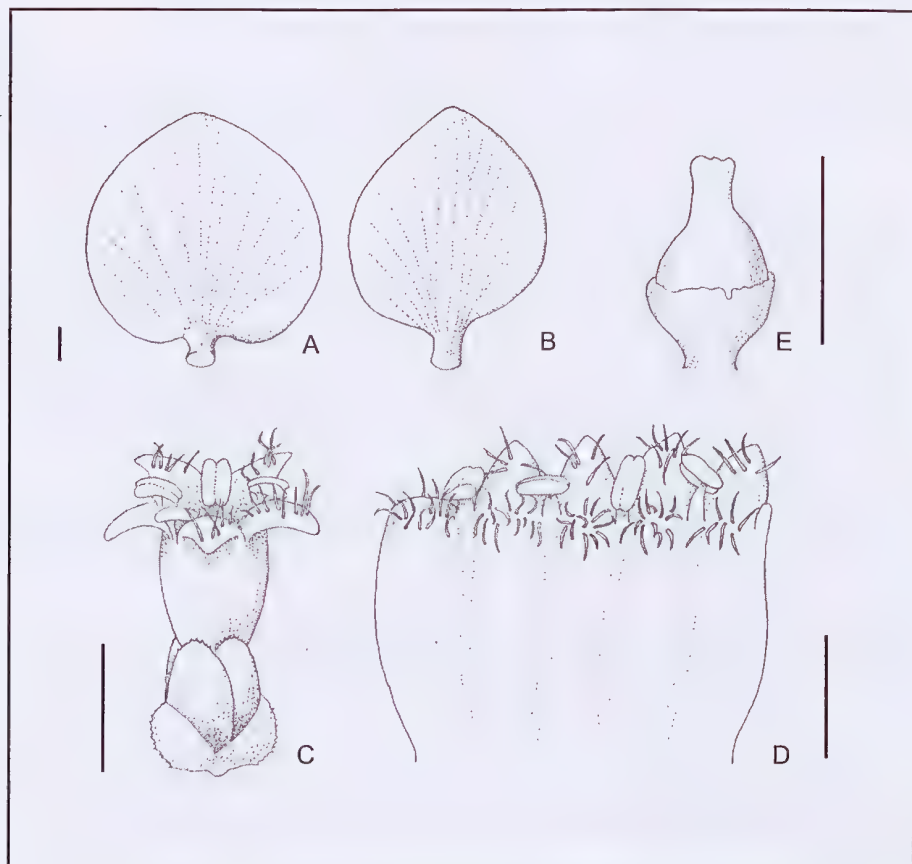


Figure 1. *Acrotriche orbicularis*. A–B – examples of variation in leaf shape (abaxial surfaces); C – flower; D – corolla slit open longitudinally; E – gynoecium. All scale bars = 1 mm. Drawn by Skye Coffey from R. Butcher & A. Markey 1306.



long, attached close to anther apex, adnate to tube just below the sinus. *Ovary* ellipsoid to obovoid, 0.8–1.0 mm long, 0.5–0.6 mm wide, glabrous, 5-locular; *style* 0.5–0.6 mm long, tapering smoothly from ovary apex, included within corolla tube; *stigma* not expanded; *nectary* annular 0.45–0.55 mm long, glabrous, irregularly and shallowly lobed. *Fruit* not seen. (Figure 1)

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 18 Sep. 2008, R. Butcher & A. Markey RB 1307 (PERTH); 24 May 2007, S. Kern, R. Jasper & D. Brassington LCH 16953 (PERTH); 18 Sep. 2008, A. Markey & R. Butcher 6243 (PERTH).

*Distribution and habitat.* *Acrotriche orbicularis* is known only from Bandalup Hill, east of Ravensthorpe, (Figure 2), where it occurs as a component of the understorey of low Eucalypt woodland, in loam soils over magnesite.

*Phenology.* The only flowering specimens seen were collected in September. This material was in late flower suggesting that July and August are likely to be the months of peak flowering.

*Etymology.* From the Latin *orbiculus* (rounded, flat with a circular outline), a reference to the leaf shape, which although rather variable on individual plants, is frequently orbicular or suborbicular.

*Conservation status.* Under the phrase-name *Acrotriche* sp. Ravensthorpe (S. Kern *et al.* LCH 16953) this species has been assigned Priority One status (DEC Conservation Codes for Western Australian Flora). There is an unvouchered record of the species from a location five to six kilometres north of Bandalup Hill which requires confirmation.

*Affinities.* In terms of its gross morphology the new species is most similar to *Acrotriche cordata* (Figure 3). The latter is widespread in near-coastal parts of Western Australia between the central west coast and the Great Australian Bight (Figure 2), and also occurs in South Australia and western Victoria. It is an exceptionally variable species in terms of its leaf shape, and within Western Australia at least, there appears to be some geographical pattern to this variability. Potential co-relating floral or fruiting differences however are not apparent.

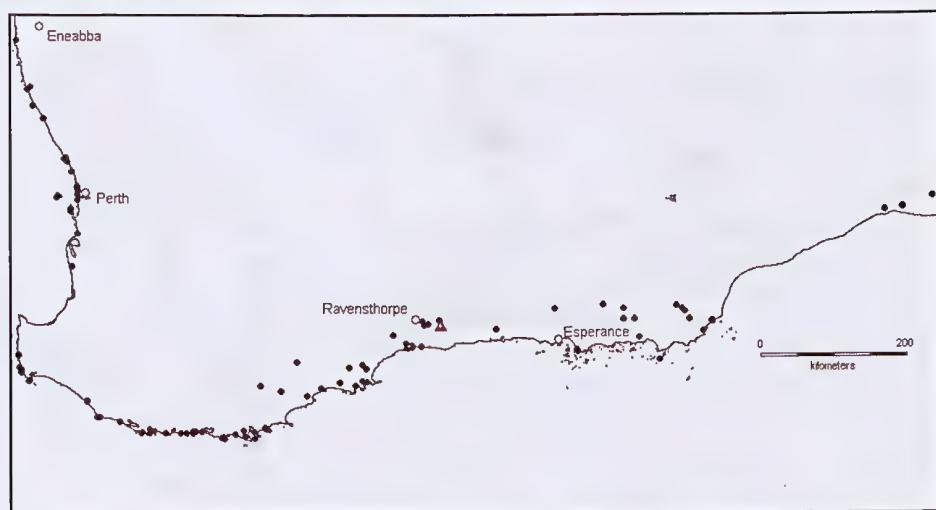


Figure 2. Distribution of *Acrotriche orbicularis* (▲) and *A. cordata* (●) in Western Australia.

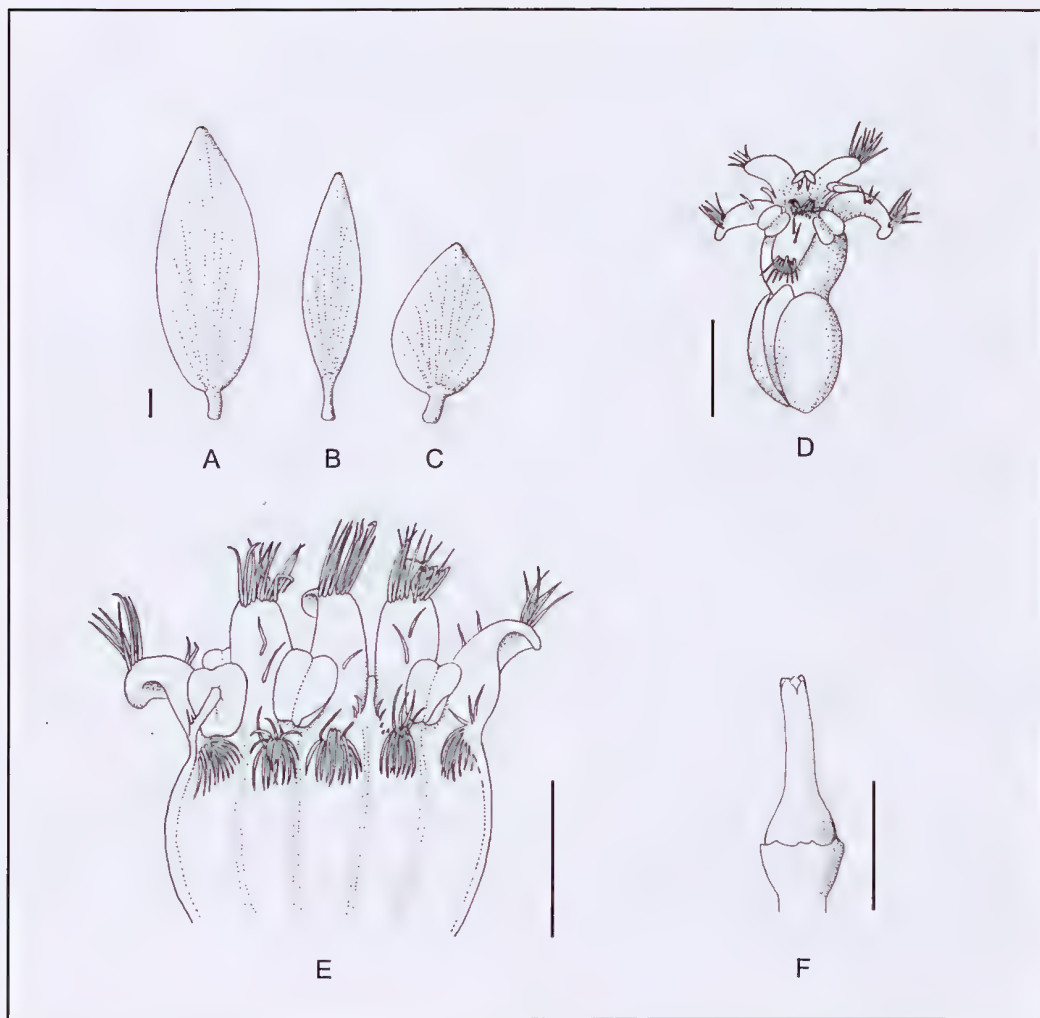


Figure 3. *Acrotriche cordata*. A–C – examples of variation in leaf shape (abaxial surfaces); D – flower; E – corolla slit open longitudinally; F – gynoecium. All scale bars = 1 mm. Drawn by Skye Coffey from S. Kern, R. Jasper & D. Brassington LCH 17212 (A); R. Spjut, G. White, R. Phillips & L. Lacy 7342 (B); S. Kern, R. Jasper & D. Brassington LCH 17067 (C); E.A. Brown 97/321, P.G. Wilson & N. Lam (E–F).

*Acrotriche cordata* is sympatric with *A. orbicularis* at the type locality of the latter. However the variant of *A. cordata* that occurs in the Ravensthorpe Range and surrounding district invariably has narrower leaves (Figure 3A–C shows leaf variation in the Ravensthorpe–Hopetoun area), and always lacks the pruinose texture of *A. orbicularis*. These foliar differences suggest that the two should be readily separable in the field. There are also several significant floral differences between the species. *Acrotriche orbicularis* can always be separated from *A. cordata* by its shorter corolla lobes (0.6–0.9 mm long compared to 1.2–1.9 mm for *A. cordata*), which are very sparsely and irregularly hairy (rather than having hairs concentrated in dense, transverse, subapical tufts), a shorter style (0.5–0.6 cf. 0.9–1.5), and relatively sparse hair tufts issuing from unmodified epidermal cells in the corolla throat (cf. dense hairs from cushion-like outgrowths).

### Acknowledgements

I would like to thank the following people for assisting in various ways in the preparation of this paper: Ryonen Butcher & Adrienne Markey for making a special effort to collect flowering material of *Acrotriche orbicularis*, Geoff Cockerton for providing valuable local information, Skye Coffey for the illustrations and technical support, Stephen Kern for first drawing my attention to the potentially new species, Juliet Wege for providing the distribution map and Paul Wilson for the Latin diagnosis.

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## ***Melaleuca* (Myrtaceae) of Western Australia: five new species, three new combinations, one new name and a new state record**

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### **Abstract**

Craven, L.A., Lepschi, B.J. & Cowley, K.J. *Melaleuca* (Myrtaceae) of Western Australia: five new species, three new combinations, one new name and a new state record. *Nuytsia* 20: 27–36(2010). Recent work has resulted in the recognition of five new species of *Melaleuca* from the south-west of Western Australia: *M. genialis* Lepschi, *M. ochroma* Lepschi, *M. protrusa* Craven & Lepschi, *M. sophisma* Lepschi, and *M. ulicoides* Craven & Lepschi. Reassessment of the taxonomic status of three previously described taxa shows that specific rank is warranted and the following three new combinations are made: *M. acutifolia* (Benth.) Craven & Lepschi, *M. calcicola* (Barlow ex Craven) Craven & Lepschi, and *M. spectabilis* (Barlow ex Craven) Craven & Lepschi. *Melaleuca citrina* Turcz. is a later homonym of *M. citrina* (Curtis) Dum.Cours. and the replacement name *M. lutea* Craven is provided. *Melaleuca viminalis* (Sol. ex Gaertn.) Byrnes, hitherto known only from eastern Australia has recently been collected from the Kimberley region of northern Western Australia.

### **Introduction**

*Melaleuca* L. is one of the larger genera of Myrtaceae and, as it is currently circumscribed, contains about 280 species. The genus is predominantly Australian with indigenous taxa also occurring in Malesia, New Caledonia, Lord Howe Island and Tasmania. Recent molecular studies (Brown *et al.* 2001; Edwards *et al.* in press; Ladiges *et al.* 1999) have indicated that the conventional circumscription of *Melaleuca* should be reconsidered; this is presently being addressed by the first author and R.D. Edwards. Since the publication of an enumeration of *Melaleuca* in Australia and Tasmania (Craven & Lepschi 1999), two new species have been described from eastern Australia (Craven & Ford 2004; Craven *et al.* 2003 [published 2004]), a study of the broombush (*M. uncinata* R.Br.) complex resulted in description of a further seven new species of the genus (Craven *et al.* 2004a), and *Callistemon* R.Br. has been included in *Melaleuca* (Craven 2006, Craven in press). Recent collectors in the southwest of Western Australia have made collections of several novel species and these are described below. In addition, new consideration of three described taxa and one previously known, but as yet undescribed, entity has concluded that the taxonomic status of these plants should be raised, and status should be given, respectively.

Nomenclatural studies have shown that the name *Melaleuca citrina* Turcz. is a later homonym of *M. citrina* (Curtis) Dum.Cours. and a new name, *M. lutea* Craven, is provided below. *Melaleuca viminalis* (Sol. ex Gaertn.) Byrnes has been collected in two widely separate districts within the Kimberley region in the north of the state; previously, this species was only known from Queensland.

## Taxonomy

**Melaleuca acutifolia** (Benth.) Craven & Lepschi, *comb. et stat. nov.*

*Melaleuca lateriflora* var. *acutifolia* Benth., *Fl. Australiensis* 3: 136 (1867); *M. lateriflora* subsp. *acutifolia* (Benth.) Barlow ex Craven, *Austral. Syst. Bot.* 12: 889 (1999). Type: Western Australia: Drummond 5th coll. 140 (*holo*: K, *n.v.*).

*Notes.* The differences in both morphology and geographic distribution between the typical form of *M. lateriflora* Benth. and its var. *acutifolia* were regarded by Barlow (Quinn *et al.* unpublished) to be sufficient for taxonomic recognition at subspecific, rather than varietal, level was warranted and the necessary taxonomic adjustment was effected in Craven & Lepschi (1999). Following comment by our colleague M. Hislop and field observations by the first and second authors, the taxonomic position of this taxon has been re-considered and it is concluded that specific rank is more appropriate. The differences between the two species are: *M. acutifolia*: leaves 3.9–8 times as long as wide, the blade 7–25 mm long and lunate, sublunate or transversely narrowly elliptic (approaching transversely linear) in transverse section, petals distinctly clawed; *M. lateriflora*: leaves 1.2–3.2 times as long as wide, the blade 4–12 mm long and transversely linear in transverse section, petals obscurely clawed.

**Melaleuca calcicola** (Barlow ex Craven) Craven & Lepschi, *comb. et stat. nov.*

*Melaleuca apodocephala* subsp. *calcicola* Barlow ex Craven, *Austral. Syst. Bot.* 12: 860 (1999). Type: Western Australia: 5 km SW of Clyde Hill, 18 Oct. 1970, *Aplin* 4274 (*holo*: CANB; *iso*: PERTH).

*Notes.* The differences between the two subspecies of *M. apodocephala* Turcz., i.e., subsp. *apodocephala* and subsp. *calcicola*, have been reassessed and it is now concluded that specific rank is warranted for subsp. *calcicola*. The differences between the two species are: *M. apodocephala*: stamens 6–13 per bundle, 1.5–3.5 mm long, the bundle claw 0.2–0.3 mm long; fruit 3.5–5 mm wide; cotyledons subobovulate (almost planoconvex); *M. calcicola*: stamens 12–23 per bundle, 5–5.5 mm long, the bundle claw 1–1.5 mm long; fruit 4.5–7.5 mm wide; cotyledons obovulate.

**Melaleuca genialis** Lepschi, *sp. nov.*

A *Melaleuca tinkeri* Craven foliis trichomatibus, sectione transversali transverse oblongis usque transverse late ellipticis, lobis calycis transverse semiellipticis, petalis trichomatibus, et cotyledonibus planoconvexis differt.

*Typus*: NE of Wagin, Western Australia [precise locality withheld for conservation reasons], 26 October 2001, *N. Gibson, K. Brown & A. Webb* 3848 (*holo*: PERTH; *iso*: CANB, distribuendi).

*Melaleuca* sp. Dongolocking (G.J. Keighery & N. Gibson 2896), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010].

Shrub to 1.2 m tall. Branchlets glabrescent, puberulous to lanuginulose-puberulous. Leaves alternate, 6.7–10 mm long, 0.8–1.1 mm wide, 6.8–14.4 times as long as wide, subsessile to shortly petiolate, blade hairy, puberulous to sericeous-lanuginulose, linear to linear-obovate, in transverse section transversely-broadly elliptic or transversely oblong, the base truncate, the apex acute but not pungent, midrib present, lateral veins absent, the oil glands moderately densely to densely distributed, distinct,



scattered. Inflorescences capitate, pseudoterminal, with 5–7 triads, 11–14 mm wide, bracteoles absent. Hypanthium pubescent, 1.5–1.7 mm long. Calyx lobes abaxially hairy, pubescent to puberulous, not costate, transversely semi-elliptic, 0.5 mm long, with a scarious marginal band 0.1 mm wide otherwise herbaceous. Petals deciduous, 0.8–1.1 mm long. Staminal ring absent. Stamens 2–5 per bundle, filaments pink to mauve to purple, 4–5 mm long, the bundle claw 0.8–1.5 mm long, 0.2–0.4 times as long as the filaments. Style 6–7.5 mm long. Ovules 6–7 per locule. Fruit 2.5–3.3 mm long, with the distal rim having obtuse sepaline teeth. Seeds brown with membranous testa, cotyledons planoconvex.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 13 Oct. 1999, G.J. Keighery & N. Gibson 2896 (CANB, PERTH *n.v.*).

*Phenology.* Flowers and fruits on specimens collected in October.

*Distribution and habitat.* *Melaleuca genialis* is known only from the two cited collections from Dongolocking Nature Reserve, near Wagin in south-western Western Australia (Figure 1). It grows in open woodland over shrubland on brown clay or grey gravelly clay.

*Conservation status.* Recently listed as Priority Two under the the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora. The IUCN Red List category Vulnerable (IUCN, 2001) is applicable as the populations of the species are thought to be few; perhaps there is only a single population as the species presently is known only from Dongolocking Nature Reserve.

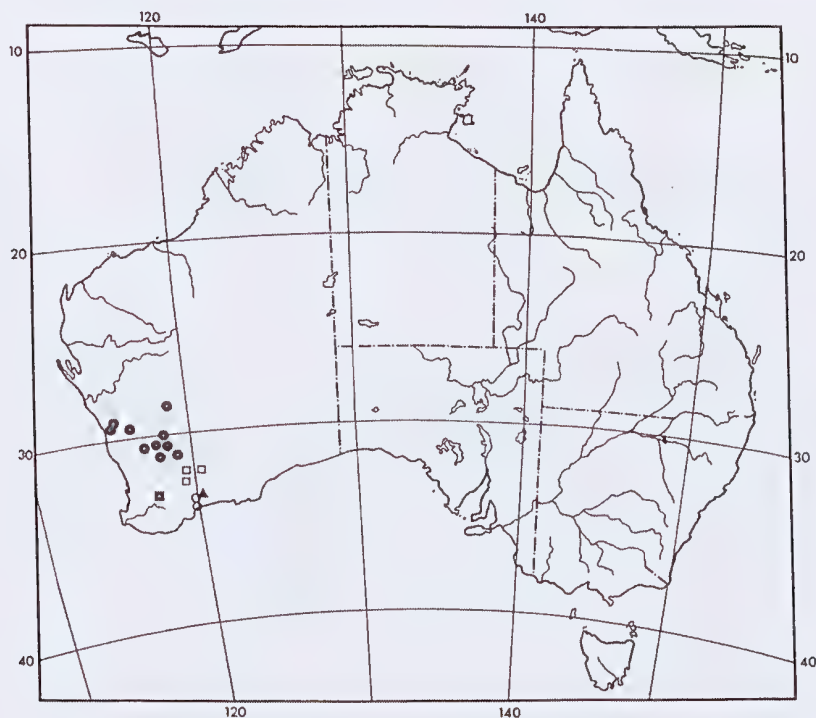


Figure 1. Distribution of *Melaleuca genialis* (■), *M. ochroma* (□), *M. prostrata* (●), *M. sophisma* (▲) and *M. ulicoides* (○) in Western Australia.

*Etymology.* From the Latin *genialis*, delightful, jovial, pleasant, genial, in reference to the Western Australian Herbarium Database Team of the mid–late 1990s: Sue Carroll, Meriel Falconer and Kaye Veryard, all of whom possess these qualities in abundance.

*Notes.* *Melaleuca genialis* may be related to *M. tinker* Craven from which it can be distinguished as follows: *M. genialis*: leaves hairy, the blade transversely oblong to transversely broadly elliptic in transverse section, calyx lobes transversely semi-elliptic, petals hairy, cotyledons planoconvex; *M. tinker*: leaves glabrescent, the blade transversely elliptic to transversely narrowly elliptic in transverse section, calyx lobes broadly ovate or triangular, petals glabrous, cotyledons obvolvate.

In herbarium annotations, on labels, etc., this species has been variously called *Melaleuca* sp. Wagin or *Melaleuca* sp. Dongolocking (G.J.Keighery & N.Gibson 2896).

***Melaleuca lutea* Craven, *nom. nov.***

Replaced name: *Melaleuca citrina* Turcz., *Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg* 10: 341 (1852), *nom. illeg.*, non Dum.Cours. (1802). *Type*: Western Australia: *Drummond* 5th coll. 148 (*holo*: KW; *iso*: BM, G, K, MEL, W).

*Notes.* Dumont de Courset (1802) published the combination *M. citrina* (Curtis) Dum.Cours. 50 years before the publication of *M. citrina* Turcz. (Turczaninow 1852) and, under the ICBN (McNeill *et al.* 2006), the latter name must be replaced.

*Etymology.* From the Latin *luteus*, yellow, in reference to the flower colour of this species.

***Melaleuca ochroma* Lepschi, *sp. nov.***

A *Melaleuca subfalcata* Turcz. foliis trichomatibus strictis, sectione transversali vade lunata; hypanthio trichomatibus strictis; staminibus 4.3–7.2 mm longis; et stylo 6.5–7.2 mm longo differt.

*Typus*: E of Hyden, Western Australia [precise locality withheld for conservation reasons], 31 October 2000, B.J. Lepschi & L.A. Craven 4469 (*holo*: CANB; *iso*: PERTH).

Shrub 0.7–2.5 m tall; bark hard, fibrous. Branchlets glabrescent, densely to very densely lanuginulose to lanuginose-pubescent. Leaves alternate, 13.5–19 mm long, 1–1.3 mm wide, 11–17 times as long as wide, shortly petiolate, blade glabrescent, densely to very densely lanuginulose to lanuginose-pubescent, linear, though narrowly obovate when young, in transverse section shallowly lunate, the base truncate, the apex acute and pungent, the veins obscure, the oil glands densely distributed, distinct, scattered. Inflorescence spicate, axillary, with 17–35 monads, 13–19 mm wide, bracteoles absent. Hypanthium puberulous, 1.2–2.2 mm long. Calyx lobes abaxially hairy, pubescent to sericeous-pubescent, not costate, triangular or broadly ovate, 1.4–1.6 mm long, with a scarious marginal band 1–3 mm wide otherwise herbaceous. Petals deciduous, 2.4–3.5 mm long. Staminal ring absent. Stamens 13–24 per bundle, 2-seriate, filaments pink to mauve, 4.3–7.2 mm long, the bundle claw 4.1–4.6 mm long, 0.9–1.7 times as long as the filaments. Style 6.5–7.2 mm long. Ovules 66–79 per locule. Fruit 3–4.4 mm long, with the distal rim flat or more or less so. Seeds brown with coriaceous testa, cotyledons planoconvex.

*Other specimens examined.* WESTERN AUSTRALIA: Frank Hann National Park, [precise locality withheld] 12 Nov. 2001, *M. Hislop* 2476 (CANB, PERTH); 13 Nov. 1989, *B.H. Smith* 1251 (CANB, MEL *n.v.*, PERTH *n.v.*).

*Phenology.* Flowers and fruit on specimens collected in October and November.

*Distribution and habitat.* *Melaleuca ochroma* occurs in southwestern Western Australia near Mt Holland, south of Southern Cross in Frank Hann National Park, and east of Hyden towards Norseman (Figure 1). It grows in *Melaleuca* shrubland (at the type locality, with nine other species of this genus) with emergent mallee eucalypts, in very open mallee over dense shrubs of *Melaleuca lateriflora*, *M. sapientes* and *Grevillea huegelii*, and in *Eucalyptus wandoo* woodland, on brown clay, whitish sandy-clay, brown clay loam, and sandy loam.

*Conservation status.* Recently listed as Priority Three under DEC Conservation Codes for Western Australian Flora. The IUCN Red List category Vulnerable (IUCN, 2001) is applicable as the populations of the species are thought to be few, although at least several of them occur in protected areas and all occur in areas that are not suitable for agricultural use.

*Etymology.* From the Greek *ochroma*, paleness, wanness, in reference to the pale, washed out colour of the staminal filaments.

*Notes.* *Melaleuca ochroma* is putatively closely related to *M. subfalcata* Turcz. The two species differ in the following features: *M. ochroma*: leaves with straight hairs, in transverse section shallowly lunate; hypanthium hairs straight; stamens 4.3–7.2 mm long; style 6.5–7.2 mm long; *M. subfalcata*: leaves with crisped or flexuous-crisped hairs, in transverse section depressed obovate or transversely semielliptic; hypanthium hairs flexuous or crisped; stamens 8–13 mm long; style 7.5–14 mm long.

### ***Melaleuca protrusa* Craven & Lepschi, *sp. nov.***

A *Melaleuca hamata* Fielding & Gardner hypanthio sericeo vel sericeipubescenti, stylo 4.7–5.5 mm longo, et fructibus apice protrusis differt.

*Typus:* 119.1 km NE of Paynes Find on the Sandstone road (22.8 km SW of the Diemal-Youanmi road), Western Australia, 24 October 2000, *W. O'Sullivan* 1122 (*holo:* CANB; *iso:* L, PERTH *n.v.*).

Shrub 1.8–4 m tall; basal bark papery. Branchlets glabrous. Leaves alternate, 40–90 mm long, 0.9–1.5 mm wide, 26–100 times as long as wide, subsessile to short-petiolate, blade glabrescent, sericeous to (rarely) sericeous-pubescent, linear, in transverse section transversely broadly elliptic, the base parallel, the apex acuminate with a recurved mucro, midrib present, lateral veins absent, the oil glands not visible. Inflorescences capitate, pseudoterminal or lateral, with 10–16 triads, 7–11 mm wide, bracteoles absent. Hypanthium sericeous, or sericeous-pubescent, 1.3±1.8 mm long. Calyx lobes abaxially glabrous, not costate, broadly elliptic, 0.5–0.8 mm long, scarious throughout. Petals caducous, 0.8–1.8 mm long. Staminal ring absent. Stamens 3–5 per bundle, filaments cream to yellow, 3–4 mm long, the bundle claw 1.8–2.6 mm long, 0.5–0.6 times as long as the filaments. Style 4.7–5.5 mm long. Ovules 14–28 per locule. Infructescence appearing rough or cobbled due to the protrusive fruit apices; fruit 2–3 mm long, with the distal rim flat or more or less so. Seeds brown with membranous testa, cotyledons planoconvex.

*Selected other specimens examined.* WESTERN AUSTRALIA: *c.* 7.6 km E of the road junction at Youanmi towards Sandstone, 21 Jul. 1999, *J.R. Connors & D. Nicolle* 1041 (CANB); Perce Farm, W of Mullewa, 30 Sep. 1999, *R. Davis* 9042 (CANB, PERTH *n.v.*); Petrudor Rock, SE of Dalwallinu on main track through reserve, 17 Sep. 1999, *M. Hislop* 1671 (CANB, PERTH *n.v.*); *c.* 1 km E of



Burakin East Road on Booralaming–Kulja road, c. 10.5 km E of Burakin, 6 Sep. 1997, *B.J. Lepschi & T.R. Lally* 3512 (CANB, MEL, PERTH); on the Paynes Find-Sandstone road, 7.8 km NE of the Mount Magnet Road, 24 Oct. 2000, *W. O'Sullivan* 1125 (A, CANB, MEL, PERTH *n.v.*); on the Paynes Find-Sandstone road, 7.8 km NE of the Mount Magnet Road, 24 Oct. 2000, *W. O'Sullivan* 1126 (BRI, CANB, P, PERTH *n.v.*); E of Snake Soak Tank (off Welbungin–Wialki road, SW of Wialki, 1 Nov. 2000, *W. O'Sullivan* 1151 (CANB, G, NSW, PERTH *n.v.*); on vermin proof fence road, 2.5 km N of Wanarra road, at junction of track to Lake Monger lookout, 29 Apr. 2001, *W. O'Sullivan & D. Huxtable* 1367 (CANB, PERTH *n.v.*); W of Wattoning North Road (NW of Mukinbudin), 19 Apr. 2002, *W. O'Sullivan* 1639 (CANB, PERTH *n.v.*); on Corinthia East road, 1.5 km East of Bullfinch road (between Bullfinch and Southern Cross), 1 Oct. 2002, *W. O'Sullivan* 1901 (AD, CANB, L, PERTH *n.v.*); Morrison road, 9.2 km E of Mukinbudin–Bullfinch road, 3 Dec. 2003, *W. O'Sullivan* 2111 (CANB, PERTH *n.v.*).

*Phenology.* Flowers on specimens collected from September to October and December; fruit on specimens collected in April, July and from September to December.

*Distribution and habitat.* *Melaleuca protrusa* occurs in southwestern Western Australia in an area bounded by Mullewa and Dallwallinu, east to Sandstone and Southern Cross (Figure 1). It grows in open tree-mallee over shrub thicket, on either brown sandy loam, sandy clay-loam, clay, gravelly sand or gravelly loam over granite.

*Conservation status.* Under the DEC Conservation Codes for Western Australian Flora criteria, *M. protrusa* is not listed as it does not satisfy any of the listed criteria for conservation. The IUCN Red List category Least Concern (IUCN 2001) is applicable as the populations of the species are numerous and widely spread.

*Etymology.* From the Latin, *pro-*, forward and *trusus*, thrust, in reference to the apices of the fruiting hypanthia that protrude from the closely packed, more or less spheroidal fruit clusters, a diagnostic feature of the species.

*Notes.* *Melaleuca protrusa* is a member of the *M. uncinata* R.Br. group, the broombush species group, that was recently revised by Craven *et al.* (2004a). Within this group it appears to be most closely related to *M. hamata* Fielding & Gardner from which it may be distinguished by the following suite of character states: *M. protrusa*: hypanthium sericeous or sericeous-pubescent; style 4.7–5.5 mm long; fruit apex protrusive, the infructescence appearing rough or cobbled; *M. hamata*: hypanthium puberulous or pubescent, or lanuginose- to lanuginulose-pubescent; style 6.5–11.5 mm long; fruit apex not protrusive, the infructescence appearing smoothish.

In herbarium annotations, on labels, etc., this species has been variously called *Melaleuca* WOS ‘minefruit’, *Melaleuca* sp. Mine fruit (W. O'Sullivan 1629), or has been identified as *Melaleuca uncinata* R.Br. or *Melaleuca hamata* Fielding & Gardner.

***Melaleuca sophisma* Lepschi, *sp. nov.***

*A Melaleuca cliffortioides* Diels ramulis glabris, foliis reflexis 3–5-venatis, floribus triadis, hypanthio glabro, stylo 6.8–10.6 mm longo; et fructibus 1.7–3 mm longis differt.

*Typus:* Kundip, Western Australia [precise locality withheld for conservation reasons], 5 November 2004, *G.F. Craig* 6146 (*holo:* PERTH; *iso:* CANB, gfc<sup>1</sup>, distribuendi).

<sup>1</sup> G.F. Craig personal herbarium.

*Melaleuca* sp. Kundip (G.F. Craig 6020), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010].

Shrub to 1–2 m tall; bark rough, deeply fissured towards base, grey. Branchlets glabrous. Leaves alternate, reflexed, 3.1–6.3 mm long, 1.1–2.1 mm wide, 1.7–5 times as long as wide, sessile, blade early glabrescent, ciliate on youngest growth only, ovate, in transverse section lunate, the base truncate, the apex acute, recurved to incurved, not pungent, the veins 3–5, the oil glands densely distributed, distinct, more or less in rows. Inflorescences capitate, axillary, with 3–5 triads, 13–18 mm wide, bracteoles present on each flower. Hypanthium glabrous, 1.3–2.2 mm long. Calyx lobes abaxially glabrous, costate, triangular or broadly ovate, 1.2–1.4 mm long, with a scarious marginal band 1 mm wide otherwise herbaceous. Petals deciduous, 2–2.3 mm long. Staminal ring absent. Stamens 12–15 per bundle, filaments white at anthesis but darkening to cream or yellow with age, 6.9–9 mm long, the bundle claw 3.7–4.7 mm long, 0.5–0.6 times as long as the filaments. Style 6.8–10.6 mm long. Ovules 17–21 per locule. Fruit 1.7–3 mm long, with the distal rim having obtuse sepaline teeth. Seeds white with coriaceous testa, cotyledons planoconvex.

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 Sep. 2005, *S. Barrett* 1402 (PERTH); 17 Dec. 2003, *G.F. Craig* 6020 (PERTH); 5 Nov. 2004, *G.F. Craig* 6147 (PERTH); 2003, *Landcare Services* LCS 10298 (PERTH).

*Phenology.* Flowers on specimens collected from November to December; fruit on specimens collected in September, November and December.

*Distribution and habitat.* *Melaleuca sophisma* occupies a very restricted range in the Kundip district in southwestern Western Australia (Figure 1). It grows in mallee to mallet shrubland over heath on brown sandy loam or grey clay loam with stony schist and quartz.

*Conservation status.* Listed as Priority One under DEC Conservation Codes for Western Australian Flora as *Melaleuca* sp. Kundip (G.F. Craig 6020) by Smith (2010). The IUCN Red List category Vulnerable (IUCN 2001) is applicable as there are few known populations of the species.

*Etymology.* From the Greek *sophisma*, false conclusion, fallacy, in reference to the similarity of the species to *M. cliffortioides* Diels with which the plant at first was associated.

*Notes.* *Melaleuca sophisma* superficially resembles *M. cliffortioides* but can be distinguished from this species in the following features: *M. sophisma*: branchlets glabrous; leaves reflexed, veins 3–5; flowers in triads; hypanthium glabrous; style 6.8–10.6 mm long; fruit 1.7–3 mm long; *M. cliffortioides*: branchlets hairy; leaves spreading, veins 9–11; flowers in monads; hypanthium hairy; style c. 13 mm long; fruit 4–5 mm long.

***Melaleuca spectabilis*** (Barlow ex Craven) Craven & Lepschi, *comb. et stat. nov.*

*Melaleuca longistaminea* subsp. *spectabilis* Barlow ex Craven, *Austral. Syst. Bot.* 12: 889 (1999). *Type:* Western Australia: 17 km N of outskirts of Geraldton on the North West Coastal Highway, 2 Oct. 1988, *J.M. Fox* 88/098 (*holo:* CANB; *iso:* K, MEL, PERTH, WELT *n.v.*).

*Notes.* Craven & Lepschi (1999) recognised two subspecies within *M. longistaminea* (F.Muell.) Barlow ex Craven. Given the differences in their respective phenotypes, their taxonomic status has

been reconsidered and subsp. *spectabilis* is here raised to species rank. The differences between the two species are: *M. spectabilis*: floral bract subtending the monad (i.e., the flower) 5–8 mm long; bracteoles subtending each flower 5–8 mm long, linear, narrowly obovate, linear-elliptic, or linear-obovate; petals 4.5–6.5 mm long; cotyledons planoconvex; *M. longistaminea*: floral bract 1.5–2.7 mm long; bracteoles 1.5–1.8 mm long, elliptic, narrowly elliptic, or narrowly ovate; petals 3–3.7 mm long; cotyledons obvolute.

The name *Melaleuca spectabilis* Raeusch. (Raueschel 1797), possibly referable to *Metrosideros* Banks ex Gaertn., is a *nomen nudum* and has no nomenclatural standing under the ICBN (McNeill *et al.* 2006).

***Melaleuca ulicoides* Craven & Lepschi, *sp. nov.***

A *Melaleuca coronicarpa* D.A.Herb. foliis 5-venatis, vena media pagina abaxiali prominenti; hypanthio sericeo; staminibus 13–17 mm longis; stylo 15–18 mm longo; in fructu lobis calycis sublnognosis differt.

*Typus*: SSW of Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 1 November 1965, A.S. George 7224 (*holo*: CANB; *iso*: PERTH).

*Melaleuca* sp. Gorse (A.S. George 7224), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed June 2010].

Shrub to 0.6–1 m tall. Branchlets glabrescent, pubescent. Leaves alternate, 3.9–12 mm long, 1.1–2.7 mm wide, 2.3–7.5 times as long as wide, sessile, blade glabrescent, ciliate and long pubescent to sericeous-pubescent, narrowly triangular to narrowly ovate, in transverse section lunate, the base truncate, the apex narrowly acute with a pungent mucro, the veins 5 but mostly obscure except for the midrib, the oil glands densely distributed, distinct. Inflorescences capitate, terminal, with 1–3 monads, 5–20 mm wide, bracteoles present on each flower. Hypanthium sericeous, 2–3 mm long. Calyx lobes abaxially glabrescent, sericeous, costate, broadly or transversely ovate, 1.6–2.1 mm long, with a scarious marginal band 0.2–0.4 mm wide otherwise herbaceous. Petals deciduous, 3–4.5 mm long. Staminal ring present. Stamens 18–28 per bundle, filaments cream, 13–17 mm long, the bundle claw 4.2–11.2 mm long, 0.2–0.9 times as long as the filaments. Style 15–18 mm long. Ovules 30–52 per locule. Fruit 2.7–4 mm long, with the distal rim having round sepaline teeth. Seeds brown with membranous testa, cotyledons planoconvex.

*Other specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 7 Nov. 1969, K.M. Allan 173 (PERTH); 16 Feb. 1998, G.F. Craig 3444 (PERTH); 18 Feb. 1998, G.F. Craig 3444B (PERTH); 20 Feb. 1998, G.F. Craig 3675 (PERTH); 20 Feb. 1998, G.F. Craig 3675B (CANB, gfc, PERTH); Oct. 1969, K. Newbey 2915 (PERTH).

*Phenology*. Flowers on specimens collected from October to November; fruit on specimens collected in November and February.

*Distribution and habitat*. *Melaleuca ulicoides* occurs in southwestern Western Australia from near Hopetoun north to the Ravensthorpe area (Figure 1). It grows in open mallee and heath, on brown loamy clay with small gravel and laterite.



*Conservation status.* Recently listed under DEC Conservation Codes for Western Australian Flora as Priority Two. The IUCN Red List category Vulnerable (IUCN, 2001) is applicable as there are relatively few populations of the species.

*Etymology.* The specific epithet is derived from the generic name *Ulex*, in reference to the similarity in habit between this plant and gorse, *Ulex europaeus* L.

*Notes.* *Melaleuca ulicoides* is distinctive due to the densely congested branchlets. The species is related to *M. coronicarpa* and the two may be distinguished as follows: *M. ulicoides*: leaves 5-veined, the midrib prominent on the abaxial surface; hypanthium sericeous; calyx lobes sericeous; stamens 13–17 mm long; style 15–18 mm long; in fruit, the calyx lobes developed into subwoody teeth (i.e., into sepaline teeth); *M. coronicarpa*: leaves 7–17-veined, the midrib plane on the abaxial surface; hypanthium pubescent or lanuginose-pubescent; calyx lobes pubescent; stamens 6–11.5 mm long; style 7.2–11.2 mm long; in fruit, the calyx lobes persistent and immersed in the hypanthium wall.

In herbarium annotations, on labels, etc., this species variously has been called *Melaleuca* sp. Gorse (A.S.George 7224), *Melaleuca coronicarpa* ‘gorse’, or *Melaleuca coronicarpa* subsp. *rigens* extreme ‘gorse-like biotype’ Barlow & Thiele.

***Melaleuca viminalis*** (Sol. ex Gaertn.) Byrnes, *Austrobaileya* 2: 75 (1984)

*Metrosideros viminalis* Sol. ex Gaertn., *Fruct. sem.* pl. 1: 171, t. 34, fig. 4 (1788); *Callistemon viminalis* (Sol. ex Gaertn.) G.Don, in Loudon, *Hort. brit.* 197 (1830).

*Specimens examined.* WESTERN AUSTRALIA: Gundarara Creek, west Kimberley, 19 Aug. 2001, W. O’Sullivan & D. Dureau 50 (CANB, PERTH *n.v.*); on unnamed creekline N of Prince Regent River (tributary), 21 Aug. 2001, W. O’Sullivan & D. Dureau 71 (CANB, PERTH *n.v.*); on unnamed creekline N of Prince Regent River, 21 Aug. 2001, W. O’Sullivan & D. Dureau 78 (CANB, PERTH *n.v.*); Revolver Creek Falls, 52 km and SSW of Kununurra, Feb. 1998, T. Handasyde 99 038 (KNR)<sup>2</sup>.

*Distribution and habitat.* *Melaleuca viminalis* occurs in the Kimberley region of Western Australia, in Queensland and in New South Wales. In Western Australia it has been collected in a stony riverbed in rapids with sandstone rocks overlying volcanics, in the creekline of sandstone gorges in sand among rocks, and around a pool below a waterfall. Associated plant species include *Celtis* L. sp., *Albizia lebbbeck* (L.) Benth., *Lophostemon* Schott sp., *Timonius timon* (Spreng.) Merr., *Pandanus aquaticus* F.Muell., *Melia azedarach* L., *Syzygium* Gaertn. spp., and *Ficus* L. sp.

*Conservation status.* Recently listed under DEC Conservation Codes for Western Australian Flora as Priority Two. Under the IUCN Red List categories (IUCN 2001), however, the category Least Concern is applicable as nationally the species is not threatened.

*Notes.* The cited collections of *M. viminalis* in Western Australia are of particular interest as the species was previously known only from Queensland and New South Wales, where the majority of collections have been made east of the Great Dividing Range. The most westerly indigenous occurrence known until now is in the Boulia district, Queensland, although there is a record from Lawn Hill Creek, Queensland which requires verification as the plant may have been cultivated in a homestead garden. The Western Australian populations occur at localities distant from possible places of cultivation and cannot be regarded as originating from plants introduced from eastern Australia.

<sup>2</sup> Dept. of Environment and Conservation Regional Herbarium at Kununurra.

At one of the west Kimberley locations (Gungarara Creek), *M. viminalis* occurred with an undescribed species of *Backhousia* Hook. & Harv. (Myrtaceae), the first species of this genus discovered in Western Australia. The botanical exploration of the Kimberley region is hampered by difficulties in gaining access due to the rugged nature of the country but its flora is being increasingly enriched by the discovery of genera and/or species that a few decades ago were considered restricted to northeastern and/or eastern Australia. *Melaleuca viminalis* and the undescribed *Backhousia* sp. are two such species.

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## A revision of the *Micromyrtus racemosa* complex (Myrtaceae: Chamelaucieae) of south-western Australia

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### Abstract

Rye, B.L. A revision of the *Micromyrtus racemosa* complex (Myrtaceae: Chamelaucieae) of south-western Australia. *Nuytsia* 20: 37–56 (2010). The *Micromyrtus racemosa* species complex, which is endemic to south-western Australia, is revised. The complex includes two previously named species, *M. racemosa* Benth. and *M. trudgenii* Rye. Six new taxa are described here: *M. arenicola* Rye, *M. collina*, *M. greeniana*, *M. mucronulata*, *M. prochytes* and *M. rubricalyx*. Descriptions are also given for two new taxa that are considered to be too poorly known at present to name. Also included are distribution maps and a key to all members of this complex, and an illustration of *M. mucronulata* by Charles Gardner.

### Introduction

When the south-western Australian species of *Micromyrtus* Benth. (Myrtaceae) with a 10-ribbed hypanthium were revised in Rye (2006), one difficult species group, the *M. racemosa* complex, was omitted. Since then, one member of this complex has been named, as *M. trudgenii* (Rye 2007), because of its restricted distribution on one of the ironstone habitats that were the focus of a special issue of *Nuytsia*.

Most of the great variability found in the *Micromyrtus racemosa* complex occurs in the northern half of its overall range. Specimens from the southern half of the range all belong to the typical variant of the complex, i.e. *M. racemosa* s. str., and commonly have most of their leaves well spaced and almost appressed to the stem, with leaf size tending to be smallest in the south-east. Nine atypical taxa occur in the north, all largely or fully separated geographically from one another, and most of these tend to have dense clusters of long leaves, especially *M. trudgenii*. There is also a tendency for flower size to decrease towards the south-east of the range of the complex, with the largest flowers recorded from specimens occurring in the Kalbarri area and Moresby Range in the far north-west.

### Taxonomic history

When Bentham (1867) named *Micromyrtus racemosa*, he cited only two collections belonging to the complex, and hence was in no position to assess the variation within this plant group. In contrast, more than 200 specimens of the *M. racemosa* complex are currently housed at PERTH.



Revisionary studies of *Micromyrtus* by J.W. Green were begun in the 1970s, but his two publications (Green 1980, 1983) dealt only with species occurring in central and eastern Australia. As a result of his unpublished taxonomic work on the south-western Australian species, most PERTH specimens of the *Micromyrtus racemosa* complex have been housed as *M. racemosa* var. *racemosa* ms. In addition to the type variety, Green recognised four new varieties under *M. racemosa*, but two of these belonged to a different species complex and have now been described as *M. navicularis* Rye and *M. triptycha* Rye respectively (Rye 2006). The remaining two new taxa, *M. racemosa* varieties *mucronulata* ms and *prochytes* ms, do belong to the *M. racemosa* complex but, like the two taxa already described, they appear to be too distinctive to be treated as varieties.

Since 1995 one additional manuscript name and four informal names have been established for other members of the complex. Of these taxa, the two that had the most distinctive morphology were recognised at the species level as *Micromyrtus* sp. Warriedar (S.J. Patrick 1879A) and *M. rubricalyx* ms, the former now described as *M. trudgenii* (Rye 2007) and the latter validated in this paper. Three less obviously distinct variants of the complex were given informal names as varieties of *M. racemosa*.

### Current and future studies

The aim of this revision is to describe all variants in the *Micromyrtus racemosa* complex, apart from the recently published *M. trudgenii*, and to provide names where possible. Recent collections have assisted in defining most of the new members of the complex but further collections are needed, especially of fruiting material. It is important that both the habit of the plants and the habitat occupied are carefully recorded in order for future collections to be of maximum usefulness.

### Methods

Similar methods for recording measurements were used here to those described in a previous paper (Rye 2002a). Holotypes of all new taxa are lodged at PERTH. The distribution maps were plotted manually. Images obtained during the field work undertaken in this study were made available for use on FloraBase (Western Australian Herbarium 1998–).

### Taxonomy

#### Description of the *Micromyrtus racemosa* group

*Shrubs* erect, 0.3–3 m high, with slender stems. *Leaves* usually densely arranged on the smaller branchlets. *Petioles* 0.3–1 mm long. *Leaf blades* linear or very narrowly obovate in outline, 1.8–9 mm long, 0.4–1.4 mm wide, 0.25–0.6 mm thick, with apical mucro absent or up to 0.3 mm long, entire or with somewhat irregular margins, sometimes with a very narrow scarious marginal rim; lower surface flat or with an indentation along midvein and steep sides, often with two main rows of prominent oil glands and 4–18 main glands in each row; upper surface slightly convex or almost flat. *Racemes* mostly extending for 2–20 nodes, with widely spreading flowers; peduncles 0.8–3.3 mm long. *Bracteoles* caducous or deciduous, rather scarious, narrowly obovate with margins strongly incurved, 0.7–3 mm long, acute, entire. *Buds* with apex usually intermediate between hemispheric and acute (referred to below as high-hemispheric). *Flowers* 2.5–4.5 mm diam. or possibly up to 5 mm. *Hypanthium* terete, 1.4–3.7 mm long, free in distal 0.4–0.9 mm, 10-ribbed. *Sepals* fairly erect or partly spreading in

flower, erect in fruit, scarious to almost petaline, 0.1–1.5 mm long, broadly obtuse, entire, whitish or sometimes red-tinged. *Petals* widely spreading in flower, closing erect in fruit and eventually shed, more or less broadly elliptic, 1.1–2.5 mm long, white to yellow, rarely pale pink, often becoming red-tinged outside, broadly obtuse, entire. *Stamens* 10, with antipetalous ones inserted on summit of disc and antisepalous ones inserted near the middle of the free tube. *Antipetalous filaments* 0.25–0.7 mm long, slightly longer than the antisepalous filaments. *Anthers* 0.25–0.35 mm long; slits converging at base or almost parallel; gland fairly equally 3-lobed or with apical portion distinctly larger than lateral lobes. *Ovary* with 2 ovules in a terminal cavity. *Style* 0.15–0.6 mm long. *Fruit* terete, almost cylindrical but often tapering slightly from top to base, 1.5–3 mm long, 0.9–1.2 mm wide, 1-seeded; hypanthium 10-ribbed. *Seed* solitary, erect, approximately the same shape as the fruit, 1.4–2.5 mm long; testa golden brown to deep orange-brown or rarely pink-tinged, membranous.

*Distribution and habitat.* Occurs in northern and inland parts of the South West Botanical Province and in adjacent parts of the Eremaean Botanical Province, extending from Kalbarri National Park and Eurardy Station south-east to near Kondinin and inland to Diemals Station. Recorded mainly in a great variety of rocky habitats, which are favoured by most taxa, but with two of the taxa recorded entirely in sandy habitats.

*Phenology.* This complex has a long flowering season, perhaps with spasmodic flowering throughout the year, but flowering mainly from April to October, with fruiting quickly following flowering.

*Morphology.* Members of the *Micromyrtus racemosa* complex have more or less entire leaves, caducous or deciduous bracteoles, ten stamens with free (not connate) anther loculi, two ovules, a fruit that has the hypanthium terete and uniformly 10-ribbed, and petals that close to an erect position in fruit and are eventually shed. This combination of characters distinguishes the *M. racemosa* complex from all other species groups in the genus.

Differences in the measurements of the leaves and other organs are very important for separating the members of this complex (see Table 1), although some characters such as peduncle length and anther length show very little variation between taxa. Qualitative character differences are much less common, a reflection of how closely related the taxa within the complex are.

*Notes.* Members of the *Micromyrtus racemosa* complex show a pattern of geographic replacement, with only small gaps between adjacent variants but no known cases of overlap in their ranges. As well as being separated from one another, they very rarely coexist with members of other species groups within the genus. A notable exception is the co-existence of *M. mucronulata* with *M. ninghanensis* Rye. The only common species showing a large overlap in its range with the *M. racemosa* complex is *M. obovata* (Turcz.) J.W. Green. However, *M. obovata* occurs in sandy habitats and does not extend far enough north to overlap in range with the two variants of the *M. racemosa* complex that have a similar habitat. In its large area of overlap with the distribution of *M. obovata*, the *M. racemosa* complex favours rocky habitats; hence these taxa are rarely found in close proximity to one another.

All of the variants in the *M. racemosa* complex described below seem to warrant at least subspecific status, and most, if not all, of them have differentiated to a degree where it seems to be appropriate to regard them as distinct species.

**Table 1.** Morphological comparison of members of the *Micromyrtus racemosa* complex. Filament lengths were taken from the antipetalous stamens. All measurements are in millimetres and brackets indicate rare measurements.

Taxon name	<i>arenicola</i>	<i>collina</i>	<i>aff. collina</i>	<i>greeniana</i>	<i>Jingamarra</i>	<i>mucronulata</i>	<i>prochytes</i>	<i>racemosa</i>	<i>rubricalyx</i>	<i>trudgenii</i>
<b>Lengths</b>										
petiole	0.4-0.8	0.7-0.9	0.7-0.9	0.4-0.6	c. 0.5	0.4-0.5	0.4-0.6	0.3-0.6(1)	0.6-0.8	0.5-0.7
leaf blade	2.2-4	5-8.5	4-5.5	5-6	3.5-4	3.5-5.5	2.5-3.5	1.8-4(5.5)	3-6	4-9
leaf mucro	<0.1	0-0.1	0-0.1	0.1-0.3	0.1-0.3	0.1-0.15	<0.1	<0.1	<0.1	0.1-0.15
peduncle	1.5-2.2	1.5-3	2-2.5	2.5-3	1-1.5	1-2	1-3.3	1.3-3	1.5-2	0.8-2
bracteole	1.7-2.3	1.5-2	1.4-1.7	c. 2	1.5-1.8	1.6-2	0.9-1.3	1.1-2.3	2.2-3	0.7-1.3
hypanthium	2.6-3.3	2-2.5	2-2.2	3.3-3.7	c. 2.6	2.3-2.8	2-3.2	1.4-2.5	2.5-3	c. 2
sepal	0.4-0.7	0.4-0.6	0.25-0.35	0.5-0.7	c. 0.3	0.2-0.5	0.1-0.35	0.1-0.4	1.1-1.5	c. 0.2
petal	1.5-2	1.5-2.2	1.3-1.5	2-2.5	c. 1.4	1.5-2	1.3-1.5	1.1-2	1.7-2.2	1.3-1.6
filament	0.3-0.4	0.35-0.4	0.25-0.35	0.35-0.45	0.35-0.4	0.3-0.4	0.4-0.7	0.25-0.4	0.3-0.4	0.3-0.35
style	0.3-0.35	0.25-0.35	0.3-0.35	0.3-0.4	c. 0.4	0.3-0.4	0.4-0.6	0.15-0.35	0.25-0.4	c. 0.25
fruit	c. 2	1.8-2.4	c. 2.2	2.5-2.7	n.a.	1.8-2.5	2.4-3	1.5-2	c. 2.5	2.2-2.4
seed	c. 1.7	1.6-2	c. 1.7	c. 1.8	n.a.	1.5-2.3	2-2.5	1.4-1.8	c. 1.6	c. 2
<b>Widths</b>										
leaf	0.8-1.4	0.7-1	0.8-1.2	0.5-0.8	0.5-0.6	0.5-0.8	0.6-1	0.5-0.8	1.1-1.3	0.4-0.6
flower	3.5-4	3-4.5	3-4	4-4.5	3-3.5	3-3.5	3-4	2.5-4	c. 4.5	3-3.5



**Key to members of the *Micromyrtus racemosa* complex**

1. Bracteoles 2.2–3 mm long. Sepals 1.1–1.5 mm long. (Moresby Range.)..... **M. rubricalyx**
- 1: Bracteoles 0.7–2.3 mm long. Sepals 0.2–0.7 mm long
  2. Leaves 4–9 mm long, 0.4–0.6 mm wide, 0.3–0.5 mm thick, terminating in a narrow mucro 0.1–0.15 mm long. Petals pale yellow or yellow. Occurs on ironstone habitats. (Blue Hills Range area.)..... **M. trudgenii**
  - 2: Leaves usually differing from the above choice in being shorter, wider or thicker, or in lacking a mucro. Petals white or cream, rarely pale pink. Occurs in varied habitats from near Kalbarri to near Hyden, but not within the small area south of Yalgoo that is occupied by *M. trudgenii*
  3. Base of hypanthium usually exceeding width of peduncle. Antipetalous stamens with a filament 0.4–0.7 mm long. Mature style 0.4–0.6 mm long. (Woolgorong Station to near Yalgoo.)..... **M. prochytes**
  - 3: Base of hypanthium not exceeding width of peduncle. Antipetalous stamens with a filament 0.25–0.4 mm long. Mature style 0.25–0.4 mm long
  4. Leaves distinctly mucronulate; mucro 0.1–0.3 mm long
    5. Hypanthium 3.3–3.7 mm long, often tending to appear 5-ribbed at first (but 10-ribbed in fruit) and often somewhat compressed. Occurs in sandplain north of Geraldton. (Eurardy Station area.)..... **M. greeniana**
    - 5: Hypanthium usually 2.4–2.8 mm long, obviously 10-ribbed, terete. Occurs east or south-east of Geraldton, the habitat (where known) rocky.
      6. Leaves dotted with numerous small oil glands, with more than one row on each side and often 14–18 oil glands in each row; mucro stout, tapering from the acute apex of leaf, c. 0.2 mm long. (Jingemarra Station.) ..... var. **Jingemarra**
      - 6: Leaves with a single main row of large oil glands on each side, often with 10–12 oil glands per row; mucro narrow, arising suddenly from an obtuse apex, 0.1–0.15 mm long. (Paynes Find area.)..... **M. mucronulata**
  - 4: Leaves not or scarcely mucronulate; mucro (when present) up to 0.1 mm long
    7. Leaves 2.2–8.5 mm long, 0.7–1.4 mm wide. Flowers with hypanthium 2–3.3 mm long, sepals 0.25–0.7 mm long and petals 1.3–2 mm long. Occurs north of Geraldton
    8. Shrub with main stem unbranched below the erect main branches or with some bare branches, occurring in rocky habitats. Leaves 4–8.5 mm long, 0.7–1 mm wide. Hypanthium 2–2.5 mm long
      9. Leaves 4–5.5 mm long. Sepals 0.25–0.35 mm long. Occurs along river gorges. (Lower Murchison River)..... *aff.* **M. collina**
      - 9: Leaves 5–8.5 mm long. Sepals 0.4–0.6 mm long. Occurs on hills. (Moresby Range.)..... **M. collina**
    - 8: Shrub with multiple lateral leafy branchlets on the main stem below the main erect branches, occurring in sand. Leaves 2.2–4 mm long, 0.8–1.4 mm wide. Hypanthium 2.6–3.3 mm long. (Yuna area.)..... **M. arenicola**
    - 7: Leaves 1.8–4(–5.5) mm long, 0.5–0.8 mm wide. Flowers with hypanthium 1.4–2.5 mm long, sepals 0.1–0.35(–0.4) mm long and petals 1.1–1.6 mm long. Occurs east or south of Geraldton. (Mullewa area to Kondinin and Diemals Station.)..... **M. racemosa**

## New and previously named species

### 1. *Micromyrtus arenicola* Rye, *sp. nov.*

*A Micromyrtis racemosae* et *M. trudgenii* multo affinis, sed foliis latioribus, sepalis longioribus differt. Folia 2.2–4 x 0.8–1.4 mm; mucro nullus vel < 0.1 mm longus. Bracteolae 1.7–2.3 mm longae. Hypanthium 2.6–3.3 mm longum. Sepala 0.4–0.7 mm longa. Petala alba, 1.5–2 mm longa. Filamenta 0.3–0.4 mm longa.

*Typus:* c. 150 m W of a bend on Dartmoor Rd, 5.8 km E of Bulla–Whelarra road, Western Australia, 21 August 2003, *B.L. Rye* 238085 & *M.E. Trudgen* (*holo:* PERTH 06744621; *iso:* CANB, K, MEL, NSW, PERTH 07131224).

*Micromyrtus racemosa* var. north-central (*M.E. Trudgen* 2223) in Western Australian Herbarium, *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009]

Erect *shrub* usually 0.7–1.4 m high but one record 2 m high, single-stemmed at the base but with multiple short leafy lateral branches and with several main erect branches, flowering on both types of branches. *Leaves* mostly antrorse, very densely arranged on the smaller branchlets. *Petioles* 0.4–0.8 mm long. *Leaf blades* linear to narrowly obovate in outline, 2.2–4 mm long, 0.8–1.4 mm wide, 0.4–0.6 mm thick, acute or obtuse, not mucronate or with mucro less than 0.1 mm long, medium green; lower surface with an indentation along midvein and steep sides, with 4–7 prominent glands up to 0.2 mm diam.; upper surface shallowly concave or flat. *Racemes* mostly extending for 4–12 nodes; peduncles 1.5–2.2 mm long. *Bracteoles* narrowly ovate, 1.7–2.3 mm long. *Buds* with apex high-hemispheric. *Flowers* 3.5–4 mm diam. *Hypanthium* 2.6–3.3 mm long, 0.5–0.7 mm wide at midpoint, 1.3–1.5 mm diam. at summit, shiny and expanded markedly at summit at first, becoming less shiny and of more uniform width in fruit, free in distal 0.6–0.8 mm, 10-ribbed. *Sepals* depressed-ovate, 0.4–0.7 mm long, 0.6–0.8 mm wide. *Petals* broadly obovate, 1.5–2 mm long, white. *Antipetalous filaments* 0.3–0.4 mm long. *Anthers* 0.3–0.35 mm long; slits converging at base. *Style* 0.3–0.35 mm long. *Fruit* c. 2 x 1 mm. *Seed* c. 1.7 x 0.75 mm. (Figure 1)

*Selected specimens examined.* WESTERN AUSTRALIA: Yuna, 19 Aug. 1976, *A.M. Ashby* 5384 (PERTH); Bindoo Hill Nature Reserve, c. 1 km S along firebreak from Williamson Rd where road meets reserve on NW side, 3 Apr. 1994, *S.J. Patrick* 1771 (PERTH); 12.1 km S of a nameless road on another nameless road (MLV81S), 11.2 km N of Yuna–Tenindewa road, 21 Aug. 2003, *B.L. Rye* 238089 & *M.E. Trudgen* (PERTH); 24.7 miles [42 km] E of Binu on a right angle bend, 13 Sep. 1978, *M.E. Trudgen* 2223 (PERTH); 1 km E of Diepeveen Rd on Ajana East Rd, 27 Sep. 2002, *M.E. Trudgen* 21744 (PERTH).

*Distribution and habitat.* Occurs in the north of the South West Botanical Province, extending from east of Binu south to Bindoo Hill Nature Reserve. Occurs mainly in yellow or red sand, sometimes associated with sandstone outcrops, in species-rich vegetation that often includes a variety of other genera of Chamelaucieae. (Figure 2A)

*Phenology.* Flowers recorded early April to September.

*Conservation status.* This taxon appears to have a range at least 50 km long and to occur on at least two reserves.



Figure 1. *Micromyrtus arenicola*. A – habit and habitat; B – upper flowering branches. Photographs taken in current study at the type locality.





Figure 2. Distributions of members of the *Micromyrtus racemosa* complex. A – *M. arenicola*; B – *M. collina* ( $\Delta$ ), *M. aff. collina* ( $\nabla$ ), *M. mucronulata* ( $\circ$ ) and *M. prochytes* ( $\bullet$ ); C – *M. greeniana* ( $\Delta$ ), *M. rubricalyx* ( $\blacksquare$ ) and *M. trudgenii* ( $\bullet$ ); D – *M. racemosa* ( $\bullet$ ), an isolated inland locality ( $\circ$ ), *M. racemosa* var. *Jingemarra* ( $\Delta$ ).

**Etymology.** From the Latin *arena* (sandy place) and *-icola* (native of) in reference to the sandy habitat of this taxon.

**Affinities.** This taxon occurs directly north of the range of *Micromyrtus racemosa*, and is sandwiched between the ranges of *M. collina* on the west and *M. prochytes* on the east. It possibly shows the greatest approaches in morphology to these three taxa, but they all seem to be restricted to rocky habitats that are usually lateritic or granitic. *Micromyrtus arenicola* differs from *M. prochytes* in its longer sepals and other characters discussed under that taxon. It differs from *M. collina* in its shorter leaves and it has longer sepals than *M. racemosa*.

*Micromyrtus arenicola* possibly has a unique habit (Figure 1A), with short lateral leafy branches on its basal stem that have not been observed in the other taxa collected during the current study, but this character is not evident from the herbarium specimens. The same figure illustrates the unusual sandplain habitat this species favours, the only other member of the complex apparently with a preference for sandplain being *M. greeniana*. Most specimens are shorter than those of other variants, but this might reflect their greater susceptibility to fire in comparison with the taxa that occur in rocky habitats so that they are less likely to survive long enough to reach their full potential size.

*Notes.* Only one specimen had mature fruits. One recent specimen (*G.J. Keighery* 16374) is indicated on the label to be 2 m high.

## 2. *Micromyrtus collina* Rye, *sp. nov.*

A *Micromyrtis racemosae* et affinis similis praecipue differt foliis 4–8.5 x 0.7–1.2 mm, mucrone 0–0.1 mm longo, bracteolae 1.5–2 mm longae, hypanthio 2–2.5 mm longo, sepalis 0.4–0.6 mm longis, petalis albis, 1.5–2.2 mm longis, et filamentis 0.35–0.4 mm longis.

*Typus:* East Moresby Range, Western Australia [precise locality withheld for conservation reasons], 25 August 1983, *R.J. Cranfield* 2891 (*holo:* PERTH 02502690; *iso:* CBG).

*Micromyrtus racemosa* var. north-west (*R.J. Cranfield* 2891), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009].

*Shrub* 0.3–1.5 m high, with the taller specimens recorded as 0.75–1 m wide. *Leaves* mostly densely or very densely arranged and widely antrorse on the smaller branchlets, sometimes also a few less spreading ones on older stems. *Petioles* 0.7–0.9 mm long. *Leaf blades* linear to narrowly obovate in outline, 5–8.5 mm long, 0.7–1 mm wide, 0.4–0.6 mm thick, acute or obtuse, not mucronate or with mucro up to 0.1 mm long, yellowish green, somewhat shiny; lower surface with a narrow indentation along midvein and steep sides, with 8–12 prominent glands up to 0.1 mm diam.; upper surface shallowly concave or almost flat. *Racemes* mostly extending for 2–14 nodes; peduncles 1.5–3 mm long. *Bracteoles* narrowly ovate or ovate, 1.5–2 mm long. *Buds* with apex high-hemispheric. *Flowers* 3–4.5 mm diam. *Hypanthium* 2–2.5 mm long, 0.5–0.6 mm wide at midpoint, *c.* 1.3 mm diam. at summit, shiny and expanded markedly at summit at first, becoming less shiny and of more uniform width in fruit, free in distal *c.* 0.7 mm, 10-ribbed. *Sepals* depressed ovate, 0.4–0.6 mm long, 0.5–0.7 mm wide. *Petals* broadly obovate, 1.5–2.2 mm long, white, turning pink with age. *Antipetalous filaments* 0.35–0.4 mm long. *Anthers* *c.* 0.3 mm long; slits converging at base. *Style* 0.25–0.35 mm long. *Fruit* 1.8–2.4 x 0.7–0.9 mm. *Seed* 1.6–2 x *c.* 0.7 mm.

*Specimens examined.* WESTERNAUSTRALIA: all from Moresby Range [precise localities withheld] 25 Aug. 2007, *J. Brooker* 151 (PERTH); 31 July 2002, *J. Brooker* 323 (PERTH); 22 Aug. 1983, *R.J. Cranfield* 2700 (PERTH); 30 May 2008, *A. Gunness* 3020 (PERTH); 29 Aug. 1980, *G.J. Keighery* 3278 (PERTH).

*Distribution and habitat.* Occurs in the Moresby Range, often on slopes of mesas, in shrub vegetation on sandy soils over laterite and other rock types. (Figure 2B)

*Phenology.* Flowers recorded from July to September.

*Conservation status.* Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority One. This taxon is very geographically restricted, its known range being less than 30 km long.

*Etymology.* From the Latin *collinus* (inhabiting low hills).

*Affinities.* The closest relative is the poorly known taxon that is currently treated informally as *Micromyrtus* *aff. collina* and which might be sufficiently closely related to regard as a subspecies. The apparent disjunction of about 120 km between these two taxa (and in the west-coastal range of the complex as a whole) is interesting as a similar disjunction between closely related taxa has been noted in other plant groups such as the *Thryptomene stenophylla* E. Pritz. group and the *Enekbatus sessilis* Trudgen & Rye ms group. For a discussion of the morphological differences see the notes under *M. aff. collina*.

Like *Micromyrtus rubricalyx*, *M. collina* is restricted to the Moresby Range, although it is fairly widespread in the range whereas *M. rubricalyx* occurs only on its western edge. The two taxa are not known to co-exist but one of the populations of *M. collina* is found just east of where *M. rubricalyx* occurs. Differences between the two taxa are discussed under the latter.

*Notes.* Three records give the height of this taxon as only *c.* 0.3 m although one of these was from an area that had been burnt three years previously, which may have restricted the size of the plants. Even so, this taxon might tend to be the shortest variant in the *Micromyrtus racemosa* complex.

Its leaves, however, are amongst the largest found in the complex. A recent collection, *A. Gunness* 3020, has leaves up to 8.5 mm long and peduncles up to 3 mm long.

### 3. *Micromyrtus greeniana* Rye, *sp. nov.*

A *Micromyrtis racemosae* et affinis similis sed hypanthio longiore differt. Folia 5–6 × 0.5–0.8 mm; mucro 0.1–0.3 mm longus. Bracteolae caducae vel deciduae, *c.* 2 mm longae. Hypanthium 3.3–3.7 mm longum. Sepala 0.5–0.7 mm longa. Petala alba, 2–2.5 mm longa. Filamenta *c.* 0.4 mm longa.

*Typus:* Eurardy Station area, Western Australia [precise locality withheld for conservation reasons], 1 October 2007, *M.E. Trudgen* 22573 & *K.R. Thiele* (*holo:* PERTH 07740050; *iso:* MEL).

*Spindly shrub* 0.4–1.7 m high, width not recorded. *Leaves* mostly densely or very densely arranged and appressed to widely antrorse on the smaller branchlets, often also a few widely spreading on older stems. *Petioles* 0.4–0.6 mm long. *Leaf blades* linear to obovate in outline, 5–6 mm long, 0.5–0.8 mm wide, 0.3–0.5 mm thick, acute, medium green; lower surface with a narrow to broad indentation along midvein and steep sides, with usually numerous oil glands that are often not obvious and difficult to count; upper surface shallowly concave or almost flat; mucro 0.1–0.3 mm long, tapering from a stout base. *Racemes* often extending for 5–10 nodes; peduncles 2.5–3 mm long. *Bracteoles* narrowly ovate, *c.* 2 mm long. *Buds* with apex high-hemispheric. *Flowers* 4–4.5 mm diam. *Hypanthium* 3.3–3.7 mm long, *c.* 0.7 mm wide at midpoint, 1.2–1.5 mm diam. at summit, dull, free in distal 0.6–0.9 mm, often appearing 5-ribbed and angled (often only the antisepalous ribs obvious), with short transverse markings between the ribs. *Sepals* broadly or depressed ovate, 0.5–0.7 mm long, 0.7–0.9 mm wide. *Petals* 2–2.5 mm long, white or cream. *Antipetalous filaments* 0.35–0.45 mm long. *Anthers* *c.* 0.35 mm long; slits  $\pm$  parallel or convergent at base. *Style* 0.3–0.4 mm long. *Fruit* 2.5–2.7 × *c.* 1 mm. *Seed* *c.* 1.8 × 0.6 mm.



*Other specimens examined.* WESTERN AUSTRALIA: all from the Eurardy Station area [precise localities withheld] 29 Aug. 2003, *Wildflower Society of WA* EURA 28 (CANB, PERTH); 30 Aug. 2003, *Wildflower Society of WA* EURA 29 (PERTH); 30 Aug. 2003, *Wildflower Society of WA* EURA 30 (PERTH); 29 Aug. 2003, *Wildflower Society of WA* EURA 31 (NSW, PERTH); 29 Aug. 2003, *Wildflower Society of WA* EURA 32 (PERTH); 30 Aug. 2003, *Wildflower Society of WA* EURA 33 (PERTH).

*Distribution and habitat.* Occurs in the north of the South West Botanical Province, known from a small area on Eurardy Station, north-east of Kalbarri, in yellow sand, one record over laterite. Recorded with mallees, *Allocasuarina* or *Grevillea* dominant over varied rich vegetation including *Ecdeiocolea monostachya*. (Figure 2C)

*Phenology.* Flowers and fruits: August to October.

*Conservation status.* DEC Conservation Codes for Western Australian Flora: Priority One. This taxon is recorded from a reserve but its known range is only c. 10 km long.

*Etymology.* Named in honour of Dr John William Green, curator of the Western Australian Herbarium from 1975 to 1987, who revised the central Australian species and some of the eastern Australian species of *Micromyrtus* and also delimited the closely related monotypic genus *Corynanthera* J.W. Green.

*Affinities.* This species seems to be the most distinctive of all the members of the *Micromyrtus racemosa* complex, with the longest hypanthium and a tendency for the narrowest, most widely separated ribs in flower, with often only five ribs evident at first although it always has ten obvious ribs in fruit. Its closest relative is uncertain but it is similar to the as yet unnamed *M. racemosa* var. *Jingemarra* in having acute leaves terminated in a mucro 0.1–0.3 mm long and with minute oil glands tending to be numerous, although the glands are usually much less obvious than in var. *Jingemarra*.

The anther loculi are sometimes more or less parallel in this species, as they tend to be in *M. trudgenii*, but that species does not appear to be particularly closely related.

*Micromyrtus greeniana* occurs in the far north-west of the range of the *M. racemosa* complex just inland from the range of the Murchison gorges variant that is currently treated as *M. aff. collina*. It differs from that taxon and most other variants of the complex in its preference for sandy rather than rocky habitats.

#### 4. *Micromyrtus mucronulata* Rye, *sp. nov.*

A *Micromyrtis trudgenii* affinis sed foliis brevioribus complanatissimis, petalis albis differt. Folia 3.5–5.5 x 0.5–0.8 mm; mucro 0.1–0.15 mm longus. Bracteolae 1.6–2 mm longae. Hypanthium 2.3–2.8 mm longum. Sepala 0.2–0.5 mm longa. Petala 1.5–2 mm longa. Stamina antipetala filamentis 0.3–0.4 mm longis.

*Typus:* Paynes Find area, Western Australia [precise locality withheld for conservation reasons] 7 September 1973, *J.S. Beard* 6455 (*holo:* PERTH 01630873; *iso:* PERTH 02003570).

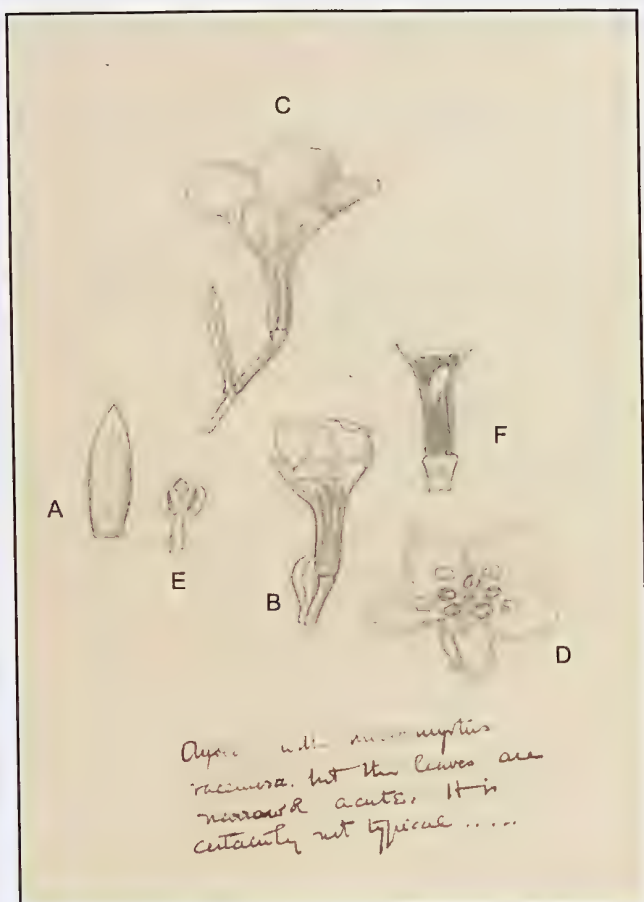


Figure 3. Pencil sketch of *Micromyrtus mucronulata* drawn by Charles Gardner on C.A. Gardner 2219. A – bracteole, B – mature bud, C – side view of flower with subtending leaf, D – top view of flower; E – anther; F – longitudinal section of ovary showing two ovules.

*Micromyrtus racemosa* var. *mucronulata* J.W. Green ms in G. Paczkowska & A.R. Chapman, *W.A. Fl.: Descr. Cat.* 399 (2000); in Western Australian Herbarium, *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009]

*Shrub* 0.5–1.5 m high. *Leaves* mostly widely antrorse and very densely arranged on the smaller branchlets, with some distant and usually appressed on longer stems. *Petioles* 0.4–0.5 mm long. *Leaf blades* linear to narrowly obovate in outline, 3.5–5.5 mm long, 0.5–0.8 mm wide, 0.25–0.35 mm thick, obtuse or acute, narrowed fairly abruptly into a slender apical mucro 0.1–0.15 mm long, somewhat shiny, pale yellowish green; lower surface with an indentation along midvein and steep sides, with a main row on each side of 8–12 main glands up to 0.1 mm diam.; upper surface shallowly concave or flat. *Racemes* mostly extending for 6–17 nodes; peduncles 1–2 mm long. *Bracteoles* narrowly ovate, 1.6–2 mm long. *Buds* with apex high-hemispheric. *Flowers* 3–3.5 mm diam. *Hypanthium* 2.3–2.8 mm long, 0.5–0.7 mm wide at midpoint, c. 1.5 mm diam. at summit, free in distal c. 0.5 mm, 10-ribbed. *Sepals* depressed ovate, 0.2–0.5 mm long, 0.6–0.8 mm wide. *Petals* broadly obovate, 1.5–2 mm long, white. *Antipetalous filaments* 0.3–0.4 mm long. *Anthers* 0.25–0.35 mm long; slits converging at base. *Style* 0.3–0.4 mm long. *Fruit* 1.8–2.5 × c. 0.8 mm. *Seed* 1.5–2.3 × 0.6–0.8 mm. (Figure 3)

*Selected specimens examined.* WESTERN AUSTRALIA: all from Paynes Find area [precise localities withheld] 30 Aug. 1976, *R. Coveny* 7914 & *B.R. Maslin* (PERTH); 10 Nov. 2004, *A. Crawford* ADC 710 (K, PERTH); 23 May 2007, *D.J. Edinger* 6245 (PERTH); 9 July 1931, *C.A. Gardner* 2219 (PERTH); 18 Apr. 1992, *S.J. Patrick* 963 (PERTH); 20 Aug. 2001, *S.J. Patrick* 3950 (PERTH); 6 Aug. 1969, *Paul G. Wilson* 8615 (PERTH).

*Distribution and habitat.* Recorded in the Paynes Find area of the Eremaean Botanical Province, on the summit or lower slopes of a hill, usually with *Allocasuarina* and *Acacia* dominant, sometimes with *Micromyrtus ninghanensis* Rye. (Figure 2B)

*Phenology.* Flowers recorded from April to November, but mainly in winter and spring.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority One. This taxon is very geographically restricted.

*Etymology.* From the diminutive of the Latin *mucro* -onis (sharp point), in reference to the minutely mucronate leaves.

*Affinities.* In its leaf morphology *Micromyrtus mucromulata* is closest to *M. trudgenii*, but its leaves tend to be shorter and more compressed, with a single, more prominent row of oil glands on each side of the midvein. It can also be distinguished by its white flowers and tends to have more convergent anther slits.

*Notes.* This variant of the *Micromyrtus racemosa* complex has apparently evolved in isolation on a single range of hills and has particularly fine leaves, which are the thinnest found in the complex and also among the narrowest. It is interesting that *M. ninghanensis* is also restricted to this region and the two species sometimes co-exist.

The presence of a pencil sketch by Charles Gardner (Figure 3) on his collection made in 1931 suggests that he may have been intending to name this taxon, as does his note below the sketch which reads 'Agrees with *Micromyrtus racemosa* but the leaves are narrower & acute. It is certainly not typical'.

In 1977 John Green nominated the specimen *J.S. Beard* 6455 as the type for his manuscript name *Micromyrtus racemosa* var. *mucromulata*. Both the epithet and type specimen are retained here but the taxon is given a higher status, as a distinct species rather than a variety.

## 5. *Micromyrtus prochytes* Rye, *sp. nov.*

*A Micromyrtis racemosae* et *M. trudgenii* multo affinis sed hypanthio ad basin magis inflato, staminibus longioribus, stylis longioribus differt. Folia 2.5–3.5 × 0.6–1 mm; mucro nullus vel < 0.1 mm longus. Bracteolae 0.9–1.3 mm longae. Hypanthium 2–3.2 mm longum. Sepala 0.1–0.35 mm longa. Petala alba, 1.3–1.5 mm longa. Filamenta 0.4–0.7 mm longa.

*Typus:* 54 miles [87 km] north of Mullewa, Western Australia, 24 August 1957, *J.W. Green* 1571 (*holo:* PERTH 01631292).



*Micromyrtus racemosa* var. *prochytes* J.W. Green ms (J.W. Green 1571) in G. Paczkowska & A.R. Chapman, *W.A. Fl.: Descr. Cat.* 399 (2000); Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009]

*Shrub* erect, 0.5–2 m high, up to at least 1 m diam. *Leaves* mostly widely antrorse, very densely arranged on the smaller branchlets. *Petioles* 0.4–0.6 mm long. *Leaf blades* narrowly obovate, 2.5–3.5 mm long, 0.6–1 mm wide, 0.35–0.5 mm thick, obtuse to acute, often mucronulate but the mucro less than 0.1 mm long, bluish green, entire but with surface minutely crinkled throughout; lower surface flat or with an indentation along midvein and fairly steep sides, with 6–8 prominent glands up to 0.1 mm diam.; upper surface slightly convex or almost flat. *Racemes* mostly extending for 2–10 nodes; peduncles 1–3.3 mm long. *Bracteoles* narrowly obovate to ovate with margins strongly incurved, 0.9–1.3 mm long, yellowish brown. *Buds* with apex hemispheric. *Flowers* 3–4 mm diam. *Hypanthium* 2–3.2 mm long, somewhat swollen at base commonly to 0.5–0.6 mm, c. 0.4 mm wide at midpoint, 1.3–1.4 mm diam. at summit, free in distal 0.4–0.8 mm, 10-ribbed. *Sepals* very depressed, 0.1–0.35 mm long, 0.4–0.9 mm wide. *Petals* 1.3–1.5 mm long, white or pink (often pink at first, becoming white, then becoming deep pink or reddish with age). *Antipetalous filaments* 0.4–0.7 mm long. *Anthers* 0.25–0.35 mm long; slits converging at base. *Style* 0.4–0.6 mm long. *Fruit* 2.4–3 mm long, 1–1.3 mm wide. *Seed* 2–2.5 x 0.8–0.9 mm.

*Selected specimens examined.* WESTERN AUSTRALIA: c. 95 miles [153 km] E of Geraldton on Yalgoo road, 16 Aug. 1967, *A.M. Ashby* 2227 (PERTH); 63 km NE of Mullewa on Wandina Station, 18 June 1985, *R.J. Cranfield* 5076 (PERTH); Woolgorong Station, 16 km S of homestead, 12 July 1994, *M. Officer* 15 (PERTH); Carnarvon–Mullewa road just S of turnoff to Woolgorong Homestead, 12 Aug. 2000, *S.J. Patrick* 3719A & *A. Cochrane* (PERTH); 10 km ESE of Yuin Homestead, Nangarrong Paddock, Aug. 1995, *J.F. Taylor* 56 (PERTH); Talling Peak, 14 Sep. 1978, *M.E. Trudgen* 2228 (PERTH); Gabyon Station, 15 Aug. 1993, *S. Van Vreeswyk* 3772 (PERTH); 100 km E of Ajana, 20 May 1966, *Paul G. Wilson* 4135 (PERTH).

*Distribution and habitat.* Occurs in the Eremaean Botanical Province, extending c. 120 km from Woolgorong Station south-east to Wurarga (west of Yalgoo), on lateritic breakaways, granite outcrops and other rocky habitats. (Figure 2B)

*Phenology.* Flowers recorded from May to September, but mainly in winter and spring.

*Conservation status.* This taxon has the second largest range known within the complex, extending for about 125 km from north to south and a similar distance from east to west.

*Etymology.* The name *prochytes* is selected because it was used as the epithet for the varietal manuscript name proposed by J.W. Green, but its etymology is uncertain. Possibly it is from the Latin *Prochytes*, an Italian island with a convoluted shape now known as Procida, perhaps in reference to the crinkled surface of the leaf. Another possibility is that it is from the Greek words *pro-* (before) and *chytos* (poured, fluid), perhaps referring to the swollen base of the hypanthium.

*Notes.* The geographic range of *Micromyrtus prochytes* is surrounded to the west and south by other members of the *M. racemosa* complex and the single collection of var. *Jingemarra* occurs on its eastern edge. Vegetatively, *M. prochytes* is distinguished by its dull, usually somewhat bluish and crinkled leaves, which never have the shiny appearance of the leaves on most *M. racemosa* specimens, although some specimens of *M. arenicola* also tend to have crinkled leaves.

Originally, *M. prochytes* was separated solely on the basis of its hypanthium being distinctly broader at the base than the peduncle, but this character varies considerably between specimens, with a few (e.g. *R.J. Cranfield* 5076) having the base of the hypanthium about the same width as the peduncle. This species has the longest stamens and style in the complex and its fruits and seeds also tend to be larger than those of other variants. A combination of characters seems necessary to reliably identify the taxon, but the range of unusual characters found in it suggests that it should be regarded as a distinct species.

**6. *Micromyrtus racemosa*** Benth., *Fl. Austral.* 3, 64 (1867). *Type*: south-western Australia, 1842–1843, *J. Drummond* coll. 2, n. 235 (*lecto*: K, *fide* Rye (2002b: 153); *isolecto*: K (two sheets), MEL 71359). See *Notes* under *M. aff. collina* for other type material examined.

*Micromyrtus racemosa* Benth. var. *racemosa* ms, Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009].

*Illustration*. Blackall & Grieve (1980: 44).

*Shrub* 0.7–3 m high, 0.1–1.5(–3) m wide. *Leaves* mostly antrorse to appressed, sometimes densely arranged and widely antrorse on the smaller branchlets. *Petioles* 0.3–0.6(–1) mm long. *Leaf blades* narrowly obovate or obovate in outline, 1.8–4(–5.5) mm long, 0.5–0.8 mm wide, 0.3–0.4 mm thick, obtuse to acute, not mucronate or with mucro less than 0.1 mm long, yellowish green, shiny, entire; lower surface flat or with an indentation along midvein and steep sides, with 4–11 prominent glands up to 0.2 mm diam.; upper surface concave to almost flat. *Racemes* mostly extending for 4–20 nodes; peduncles 1.3–3 mm long. *Bracteoles* narrowly to broadly ovate, 1.1–1.8(–2.3) mm long. *Buds* with apex hemispheric or high-hemispheric. *Flowers* 2.5–4 mm diam. *Hypanthium* 1.4–2.5 mm long, 0.35–0.5 mm wide at midpoint, 0.8–1.3 mm diam. at summit, free in distal 0.3–0.5 mm, 10-ribbed. *Sepals* depressed ovate, 0.1–0.35(–0.4) mm long, 0.35–0.6 mm wide. *Petals* 1.1–1.6(–2) mm long, white or cream, reportedly pale pink in a very small proportion of the specimens. *Antipetalous filaments* 0.25–0.4 mm long. *Anthers* 0.3–0.35 mm long; slits converging at base. *Style* 0.15–0.35 mm long. *Fruit* 1.5–2 × 0.7–1 mm. *Seed* 1.4–1.8 × 0.6–0.8 mm.

*Selected specimens examined*. WESTERNAUSTRALIA: Elphin–Korraling road, 9 km NW of Wongan Hills, 17 July 1980, *R.J. Cranfield* 1495 (CANB *n.v.*, PERTH); 7 km W of Minnivale, 8 Oct. 1981, *L.A. Craven* 6984 (PERTH); 5 km S of Burracoppin, 23 Aug. 1995, *R. Davis* 82 (PERTH); Parker Range, c. 1.3 km NW of Mt Caudan, 15 Oct. 1994, *N. Gibson & M. Lyons* 2144 (PERTH); 12 km E of Korbel Siding, 22 July 1977, *J.W. Green* 4632 (PERTH); S side of Erdman Rr, c. 12 km SE of Narembene, 2 Aug. 1997, *M. Hislop* 833 (PERTH); Fowlers Gully, Wongan Hills, 9 Sep. 1975, *K.F. Kenneally* 4606 (MEL *n.v.*, PERTH); 8.8 km S of Buntine East Rd and 0.2 km N of crossroads on Manuel Rd, N of Wubin, 14 Oct. 2003, *B.L. Rye* 231050 & *M.E. Trudgen* (AD, BRI, NSW, PERTH); 3 km N of Latham (between Perenjori and Wubin), 23 Aug. 1973, *M.E. Trudgen* 625 (PERTH); 8 miles [13 km] S of Mullewa on road to Morawa, 15 Sep. 1978, *M.E. Trudgen* 2237 (CANB *n.v.*, K *n.v.*, MEL *n.v.*, PERTH).

*Distribution and habitat*. Distributed from the Mullewa area south-east to the Kondinin area and Parker Range, a region that is mainly in the northern and central wheatbelt areas of the South West Botanical Province but extends slightly into the Eremaean Botanical Province, and there is also an isolated record from Diemals Station on the northern boundary of the South-western Interzone. Occurs in gravelly soils or on rocky habitats including ridges and breakaways, commonly on laterite, sometimes on granite, often in shrublands dominated by *Acacia* species. (Figure 2D)

The distribution of this species shows a remarkable correspondence with the Avon Wheatbelt IBRA region of Thackway & Cresswell (1995), with only the isolated Diemals Station record (*H. Pringle* 30152) occurring well outside that region.

*Phenology.* Flowers recorded from February to November but mainly from May to October.

*Conservation status.* Widespread and much more common than all other members of the complex.

*Chromosome number.*  $2n = c. 22$  (Rye 1979). The voucher, *M.E. Trudgen* 625, is given in full above.

*Affinities.* A very variable taxon, characterised by its small flowers and fruits but tending to be a tall plant, up to 3 m high. Its leaves vary from the smallest recorded in the complex to medium-sized. The northern part of its extensive range is surrounded by the ranges of five other members of the complex. It is not clear which of the other taxa is the closest relative of *M. racemosa*.

*Notes.* Specimens from north of the Wongan Hills area, and also some from that area, tend to have medium-sized leaves that are mostly densely arranged and spreading on the small branchlets. Some specimens from Wongan Hills have large flowers up to 4 mm diameter, with the hypanthium up to 2.5 mm long, sepals up to 0.4 mm long and petals up to 2 mm long; a few specimens from further north also have flowers of this size. In the broad south-eastern part of the taxon's distribution, the leaves tend to be short and mostly closely antrorse or appressed. Specimens from the south-east of the range also tend to have small flowers, sometimes with extremely short sepals and small petals as in *R. Campbell* 120A. However, there are also specimens with small leaves and flowers in the northern part of the species range, with no clear separation of the specimens into more than one category that could be recognised as subspecies or varieties.

## 7. *Micromyrtus rubricalyx* Rye, *sp. nov.*

*A Micromyrtis racemosae* et *M. trudgenii* multo affinis sed bracteolae longioribus, sepalis longioribus, semine fructus brevior differt. Folia 3–6 x 1.1–1.3 mm; mucro nullus vel < 0.1 mm longus. Bracteolae 2.2–3 mm longae. Hypanthium 2.5–3 mm longum. Sepala 1.1–1.5 mm longa. Petala alba, 1.7–2.2 mm longa. Filamenta 0.3–0.4 mm longa.

*Typus:* Moresby Range, Western Australia [precise locality withheld for conservation reasons], 21 August 2003, *B.L. Rye* 238078 & *M.E. Trudgen* (*holo:* PERTH 06744583; *iso:* CANB, K, MEL, NSW).

Erect spindly *shrub* 1–1.8 m high, not lignotuberous, with a single slender unbranched main stem at the base and few main branches, the stems shallowly furrowed, bark grey and thinly fibrous. *Leaves* mostly widely antrorse, very densely arranged on the smaller branchlets. *Petioles* 0.6–0.8 mm long. *Leaf blades* narrowly obovate in outline, 3–6 mm long, 1.1–1.3 mm wide, 0.4–0.55 mm thick, obtuse, somewhat shiny, yellowish green, entire; lower surface with an indentation along midvein and steep sides, with 5–8 prominent glands up to 0.1 mm diam. in each longitudinal row; upper surface shallowly concave or flat; mucro absent or less than 0.1 mm long. *Racemes* mostly extending for 8–15 nodes, with widely spreading flowers; peduncles 1.5–2 mm long. *Bracteoles* ovate or narrowly ovate and folded, 2.2–3 mm long, often red-tinged, acute, entire. *Buds* with apex high-hemispheric, often deep pink outside, paler pink inside when opening. *Flowers* *c.* 4.5 mm diam. *Hypanthium* 2.5–3 mm long, *c.* 0.4 mm wide at midpoint, *c.* 1.3 mm diam. at summit, free in distal *c.* 0.5 mm, 10-ribbed. *Sepals* with base



erect and upper part spreading in flower, somewhat scarious, narrowly oblong to ovate, 1.1–1.5 mm long, 0.4–0.6 mm wide, broadly obtuse, entire. *Petals* more or less broadly elliptic, 1.7–2.2 mm long, white when fully opened, broadly obtuse, entire. *Antipetalous filaments* 0.3–0.4 mm long. *Anthers* c. 0.3 mm long; slits converging at base; gland somewhat 2-lobed at base. *Style* 0.25–0.4 mm long. *Fruit* almost cylindrical but narrowed towards the base, c.  $2.5 \times 0.8$  mm, with an empty stalk-like base at least 0.5 mm long. *Seed* c.  $1.6 \times 0.6$  mm.

*Other specimens examined.* WESTERN AUSTRALIA: all from Moresby Range [precise localities withheld] 18 June 1996, A. Brown & S.J. Patrick 2607 (PERTH); 13 Sep. 1977, A.S. George 14871 (PERTH); 21 Aug. 2003, B.L. Rye 238079 & M.E. Trudgen (AD, BRI, DNA, HO, PERTH).

*Distribution and habitat.* Occurs in the north of the South West Botanical Province, known only from the western part of Moresby Range that is near Howatharra, occurring closer to the coast than any other populations of the *M. racemosa* complex. It is recorded on hillsides in open heath, at one site with *Acacia ericifolia* in 'sandy loam and sandstone'. (Figure 2C)

The type location was a north-facing slope of a moderately high hill, with brown sand over orange-brown sand at depth and sandstone rocks. Scattered *Acacia acuminata* low trees over *Calothamnus* scattered tall shrubs over *Isopogon-Gastrolobium-Grevillea* heath over *Hibbertia-Melaleuca* open shrubland over introduced weeds and native herbs (*Sowerbaea*, *Stylidium*, annual Asteraceae). Associated taxa included *Synaphea*, *Burchardia*, *Neurachne*, *Nuytsia*, *Schoenus*, *Drosera* and *Allocasuarina humilis*.

*Phenology.* Flowers recorded from June to September.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority Two. Known from two collections not more than 5 km apart, one from private property adjacent to a reserve and one from a nature reserve. *Micromyrtus rubricalyx* seems to be very restricted.

*Etymology.* From the Latin *ruber* (red, ruddy) and *calyx*, referring to the red-tinged outer surface of the sepals on the first two specimens collected, although the more recent type collection has the petals tending to be more reddish outside and the sepals pale. While several related Western Australian taxa often have the sepals red-tinged outside, they have much shorter sepals so this character is less noticeable.

*Notes.* A poorly known taxon, differing from all other members of the *Micromyrtus racemosa* complex in its much longer sepals, which are about half as long as its large petals. *Micromyrtus rubricalyx* also has the longest bracteoles recorded for the *M. racemosa* complex, and its leaves tend to have relatively few oil glands when their length is taken into consideration.

An unusual characteristic of this species is the considerable difference in length between the fruit and the enclosed seed. Some specimens of *Micromyrtus collina* also have this feature to a lesser degree. That species also shows the greatest similarity to *M. rubricalyx* in leaf size and, with sepals up to 0.6 mm long, has longer sepals than usual in the complex although still much shorter than the particularly long sepals of *M. rubricalyx*. Although its distribution includes Moresby Range, where *M. rubricalyx* appears to be endemic, *M. collina* mainly occurs in the eastern parts of the range whereas *M. rubricalyx* occurs in the western parts of the range, and *M. collina* probably tends to be a smaller plant.

**8. *Micromyrtus trudgenii*** Rye, *Nuytsia* 17: 326–329 (2007). *Type*: west of Paynes Find, Western Australia, 17 October 1975, J.Z. Weber 5166 (*holo*: PERTH 02503166; *iso*: AD *n.v.*, CANB, MEL).

For a description of this taxon see Rye (2007). Its distribution is included in Figure 2C.

### Taxa lacking formal names

The following taxa are considered to be too poorly known to describe adequately at present but appear to be distinctive.

### 9. *Micromyrtus* *aff. collina* (Murchison gorges variant)

*Shrub* *c.* 1 m high, [recorded 0.6–0.8 m wide]. *Leaves* mostly densely or very densely arranged and widely antrorse on the smaller branchlets, sometimes also a few less spreading ones on older stems. *Petioles* 0.7–0.9 mm long. *Leaf blades* linear to narrowly obovate in outline, 4–5.5 mm long, 0.8–1.2 mm wide, 0.35–0.5 mm thick, usually acute, not mucronate or with mucro up to 0.1 mm long, often yellowish green, somewhat shiny; lower surface with a narrow or broad indentation along midvein and steep sides, with 7–10 prominent glands up to 0.2 mm diam.; upper surface shallowly concave or almost flat. *Racemes* mostly extending for 3–6 nodes; peduncles 2–2.5 mm long. *Bracteoles* narrowly ovate or ovate, 1.4–1.7 mm long. *Buds* with apex high-hemispheric. *Flowers* 3–4 mm diam. *Hypanthium* 2–2.2 mm long, *c.* 0.5 mm wide at midpoint, 1.2–1.5 mm diam. at summit, shiny and expanded markedly at summit at first, becoming less shiny and of more uniform width in fruit, free in distal 0.5–0.6 mm, 10-ribbed. *Sepals* depressed ovate, 0.25–0.35 mm long, 0.4–0.6 mm wide. *Petals* broadly obovate, 1.3–1.5 mm long, white. *Antipetalous filaments* 0.25–0.35 mm long. *Anthers* *c.* 0.3 mm long; slits converging at base. *Style* 0.3–0.35 mm long. *Fruit* *c.* 2.2 × 0.8 mm. *Seed* *c.* 1.7 × 0.65 mm.

*Specimens examined*. WESTERN AUSTRALIA: all from Kalbarri National Park area [precise localities withheld] 17 Oct. 1992, D.R. & B. Bellairs 1651A (PERTH); 7 Aug. 1999, D. & B. Bellairs 6007 (PERTH); 21 June 1969, A.C. Burns 16 (PERTH, BRI *n.v.*, CANB *n.v.*, E *n.v.*).

*Distribution and habitat*. Occurs in the north of the South West Botanical Province, on the Murchison House Station and in Kalbarri National Park, on rocky breakaways in sand over sandstone. (Figure 2B)

*Phenology*. Flowers recorded from June to October.

*Affinities*. This taxon appears to be closely related to *Micromyrtus collina* and it is not clear whether it should be regarded as a separate species or just as a subspecies. It is well separated geographically, by a distance of about 120 km, and occurs in a somewhat different habitat. It has shorter sepals and tends to have shorter leaves and petals than *M. collina* but is known from too few specimens to be certain that these differences give a reliable separation of the two taxa.

*Notes*. The excluded syntype (see Rye 2000b) of *Micromyrtus racemosa* from Murchison River, collected by A.F. Oldfield probably in about 1858, may belong to this taxon.

**10. *Micromyrtus racemosa* var. *Jingemarra*** (R.J. Cranfield 5253a). Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed May 2009]

*Shrub* height unknown. *Leaves* very densely arranged and widely antrorse on the smaller branchlets. *Petioles* c. 0.5 mm long. *Leafblades* linear to narrowly obovate in outline, 3.5–4 mm long, 0.5–0.6 mm wide, 0.3–0.4 mm thick, acute, with an apical mucro 0.1–0.3 mm long, yellowish green, somewhat shiny; lower surface with a narrow to broad indentation along midvein and steep sides, dotted with numerous small glands less than 0.1 mm diam., with 14–18 glands per row; upper surface shallowly concave or almost flat. *Racemes* mostly extending for 8–12 nodes; peduncles 1–1.5 mm long. *Bracteoles* ovate, 1.5–1.8 mm long. *Buds* with apex high-hemispheric. *Flowers* 3–3.5 mm diam. *Hypanthium* c. 2.6 mm long, c. 0.5 mm wide at midpoint, c. 1.5 mm diam. at summit, free in distal c. 0.6 mm, 10-ribbed. *Sepals* broadly or depressed ovate, c. 0.3 mm long, c. 0.5 mm wide. *Petals* widely spreading in flower, broadly obovate, c. 1.4 mm long, white or cream, often becoming red-tinged outside. *Antipetalous filaments* 0.35–0.4 mm long. *Anthers* c. 0.3 mm long; slits converging at base. *Style* c. 0.4 mm long. *Fruit* not seen at maturity.

*Specimen examined.* WESTERN AUSTRALIA: Jingemarra Station [precise locality withheld], 28 June 1985, R.J. Cranfield 5253a (PERTH).

*Distribution and habitat.* Occurs in the Eremaean Botanical Province, recorded on Jingemarra Station, the habitat unknown. (Figure 2D)

*Phenology.* Flowers in June and July.

*Affinities.* See notes under *Micromyrtus greeniana*. The affinities of this taxon are not clear but it certainly should not be regarded as a variety of *M. racemosa* s. str.

*Notes.* This taxon occurs just inland of the eastern extreme of the known range of *Micromyrtus prochytes*. Its habit, fruits and habitat are all unknown. More collections are needed to determine its taxonomic status, but it appears to have a unique leaf morphology.

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## A revision of *Calothamnus quadrifidus* (Myrtaceae)

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### Abstract

George, A.S. & Gibson, N. A revision of *Calothamnus quadrifidus* (Myrtaceae). *Nuytsia* 20: 57–77 (2010). The highly variable species *Calothamnus quadrifidus* R.Br. is discussed and an infraspecific classification with eight subspecies is proposed. The following new taxa are described: *Calothamnus quadrifidus* subsp. *petraeus* A.S.George & N.Gibson, *C. quadrifidus* subsp. *seminudus* A.S.George & N.Gibson and *C. quadrifidus* subsp. *teretifolius* A.S.George & N.Gibson. New combinations are *C. quadrifidus* subsp. *angustifolius* (Ewart) A.S.George & N.Gibson, *C. quadrifidus* subsp. *asper* (Turcz.) A.S.George & N.Gibson and *C. quadrifidus* subsp. *homalophyllus* (F.Muell.) A.S.George & N.Gibson, and a new status is given for *C. quadrifidus* subsp. *obtusus* (Benth.) A.S.George & N.Gibson.

### Introduction

*Calothamnus quadrifidus* was described by Robert Brown in 1812 from specimens that he collected in January 1802 at Lucky Bay, east of where Esperance now stands, in Western Australia. It has since proved to be one of the most widespread and variable taxa in the south-western flora, extending west to Cape Naturaliste, north to Shark Bay and inland to just beyond Southern Cross. A number of names have been applied to some variants at either specific or infraspecific rank. These were reviewed by Hawkeswood (1987) who treated *C. quadrifidus*, *C. asper* Turcz, and *C. homalophyllus* F.Muell. at specific rank. He discussed the great variation in *C. quadrifidus* but recognised no infraspecific taxa. Since then, much more material has been collected that allows a more comprehensive study. The species, in the broad sense, is widely cultivated and has been used in revegetation work, unfortunately rarely using local provenances. This paper is based on morphological studies and examination of populations in the field. The largest herbarium collection is that in the Western Australian Herbarium (PERTH), some 750 sheets, and those of many other herbaria holding Australian material have been studied, especially to see type collections. A molecular study by Margaret Byrne, Department of Environment and Conservation, Perth, is currently in progress. The present work has had access to preliminary results but otherwise is based on morphological studies. It forms part of the background to an account of *Calothamnus* for the *Flora of Australia*, being prepared by A.S. George (George, in preparation).

Population sampling (5–15 plants per population) of 150 populations across the range of this species showed a high degree of within-population variation for many morphological characters (Gibson,

unpublished data). In addition, the existence of intergrades between the recognised taxa indicates that subspecies is the most appropriate taxonomic level.

The species belongs to *Calothamnus* subg. *Calothamnus*, containing the tetramerous species of the genus. As circumscribed here it includes the taxa previously known as *C. asper* Turcz. and *C. homalophyllus* F.Muell. The species is characterised by the obovate to linear or terete leaves, a non-immersed hypanthium, four bright red (rarely yellow) staminal bundles of equal size, a barrel-shaped fruit 6–14 mm long, and smooth seeds 1.5–2 mm long.

### Taxonomy

***Calothamnus quadrifidus*** R.Br., *Bot. Mag.* 37: t. 1506 (1812) as *quadrifida*

*Typus*: Lucky Bay [east of Esperance, Western Australia], January 1802, R. Brown Iter Australiense 4722 (*isosyn*: BM, E, K, MEL, NSW).

*Calothamnus quadrifidus* var. *hirsutus* Regel, *Ind. Sem. Hort. Bot. Imp. Petrop.* 39 (1856) as *quadrifida* β *hirsuta*. *Type*: none cited.

Erect or spreading *shrub* to 5 m, with or without lignotuber. *Stems* pilose or pubescent, glabrescent, or glabrous. *Leaves* narrowly linear to narrowly obovate, or terete, obtuse to acute, pilose, glabrescent, scabrid, or glabrous, commonly with small pustules, 10–50(–85) mm long, 0.8–10(–14) mm wide. *Flowers* 4-merous, usually among older leaves and commonly arranged to one side of the stem. *Hypanthium* cupular, 3–4 mm long, glabrous, or tomentose at base and glabrous above, or tomentose throughout, prominently pustulate. *Sepals* 1–2.5 mm long, tomentose inside, the margins minutely to densely ciliate. *Petals* 3.5–4 mm long, soon falling. *Staminal bundles* ± equal, 18–35 mm long, bright to deep red, rarely yellow or apricot. *Pistil* 23–42 mm long. *Fruit* barrel-shaped, 6–14 mm long, smooth or warted; 2 sepals enlarged, incurved. *Seeds* 1.4–2 mm long, smooth.

Widespread and locally common throughout south-western Western Australia from Shark Bay to Busselton, east to Israelite Bay and inland to the Southern Cross area, except a triangle between Margaret River, Denmark and Collie (Figure 1). Grows in sandy, granitic, lateritic, quartzitic or calcareous soil, in kwongan, shrubland or woodland. Flowers mainly August–December. A highly variable species with eight subspecies accepted here. Characters used to separate subspecies include habit, leaf morphology and indumentum. Narrow leaves must be observed closely (especially in the dried state) to check whether they are terete rather than linear (in the fresh state this may be done by sectioning a leaf with a scalpel).

Only subsp. *teretifolius* currently has a conservation listing (Priority Four), but none of the subspecies is considered under threat, so no statements on conservation status are given.

1. At least some leaves longer than 40 mm
2. Leaves obovate, 5–14 mm wide (Eurardy Station to Mingnew) ..... d. subsp. **homalophyllus**
- 2: Leaves narrowly obovate to linear, 1–3 mm wide (Northampton to central wheatbelt)..... c. subsp. **angustifolius**
- 1: All or most leaves less than 35 mm long



- 3. Leaves terete or semicircular in cross section
  - 4. Leaves commonly pilose; hypanthium commonly hairy (Leeman to Mandurah, inland to Darling Range) ..... **b. subsp. quadrifidus**
  - 4: Leaves glabrous; hypanthium glabrous (Vasse district) ..... **a. subsp. teretifolius**
- 3: Leaves flat
  - 5. Leaves linear but usually widening slightly in upper half
    - 6. Mature leaves glabrous
      - 7. Leaves usually 20–50 mm long; young leaves, if hairy, closely silky; hypanthium glabrous or minutely hairy (Northampton to central wheatbelt). **c. subsp. angustifolius**
      - 7: Leaves usually 10–25 mm long; young leaves, if hairy, spreading-pilose; hypanthium tomentose, sometimes in lower half only, or glabrous (Leeman to Mandurah, inland to central and southern wheatbelt and to south coast from Albany to Mt Ragged) ..... **b. subsp. quadrifidus**
    - 6: Mature leaves scabrid or hairy
      - 8. Staminal bundles 18–20 mm long; hypanthium tomentose in lower half or almost glabrous (Shark Bay to Mullewa) ..... **e. subsp. obtusus**
      - 8: Staminal bundles 25–30 mm long; hypanthium tomentose for half to its full length
        - 9. Hypanthium and sepals tomentose; fruit 10–11 mm long (eastern wheatbelt).... **g. subsp. petraeus**
        - 9: Hypanthium tomentose in lower half to two-thirds, rarely throughout; sepals glabrous except finely ciliate margins; fruit 8–9 mm long (Ironcaps to Digger Rock, Bremer Range & Peak Charles) ..... **h. subsp. seminudus**
  - 5: Leaves narrowly obovate
    - 10. All leaves less than 30 mm long
      - 11. Leaves prominently scabrid (Wongan-Hills)..... **f. subsp. asper**
      - 11: Leaves smooth or obscurely scabrid (Shark Bay to Mullewa)..... **e. subsp. obtusus**
    - 10: At least some leaves more than 30 mm long (Northampton to central wheatbelt)..... **c. subsp. angustifolius**

**a. *Calothamnus quadrifidus* subsp. *teretifolius* A.S.George & N.Gibson, *subsp. nov.***

Ad *Calothamnus quadrifidus* subsp. *quadrifidus* arcte affinis, a qua planta glabra, interdum sparsim pilosa, foliis teretibus, differt.

*Typus*: west of [Whicher] Scarp, Western Australia [precise locality withheld for conservation reasons], 19 October 1995, *N. Gibson* 2387 (*holo*: PERTH 04518748; *iso*: BRI, CANB).

*Calothamnus* sp. Whicher (B.J. Keighery & N. Gibson 230), in G. Paczkowska & A. Chapman, *West. Austral. Fl.: Desc. Cat.* p. 350 (2000); Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

*Shrub* to 5 m tall, with or without lignotuber. *Stems* glabrous or sparsely pilose when young. *Leaves* terete, obtuse or shortly mucronate, 15–35 mm long, 0.6–1 mm wide, glabrous. *Hypanthium* glabrous, or variously hairy. *Staminal bundles* 26–29 mm long. *Fruit* 6.5–9 mm long, smooth. (Figure 2)

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons] 12 Dec. 2001, *R.J. Cranfield* 17664 (PERTH); 7 Dec. 1985, *D.B. Foreman* 1537 (MEL, PERTH); 19 Oct. 1985, *N. Gibson* 2386 (PERTH); 11 Nov. 1993, *B.J. Keighery & N. Gibson* 230b (PERTH); 8 Nov. 1992, *B.J. Keighery & N. Gibson* 664 (PERTH).

*Distribution and habitat.* Occurs inland from Busselton in clay with ironstone, wet in winter, with tall shrubland. (Figure 1)

*Phenology.* Flowers September–December.

*Conservation status.* Listed as Priority Four under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora under the phrase name *Calothamnus* sp. Whicher (B.J. Keighery & N. Gibson 230) by Smith (2010).

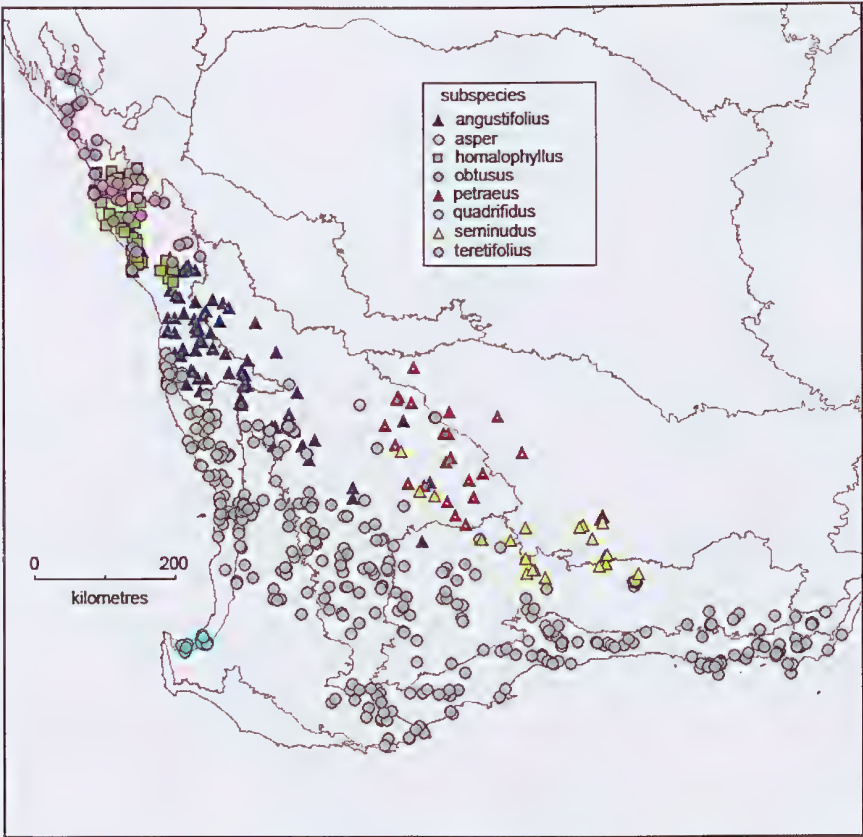


Figure 1. Distribution of the subspecies of *Calothamnus quadrifidus* in south-western Australia, with Version 6.1 IBRA Regions (Department of Environment, Water, Heritage and the Arts, 2008) shown in grey.

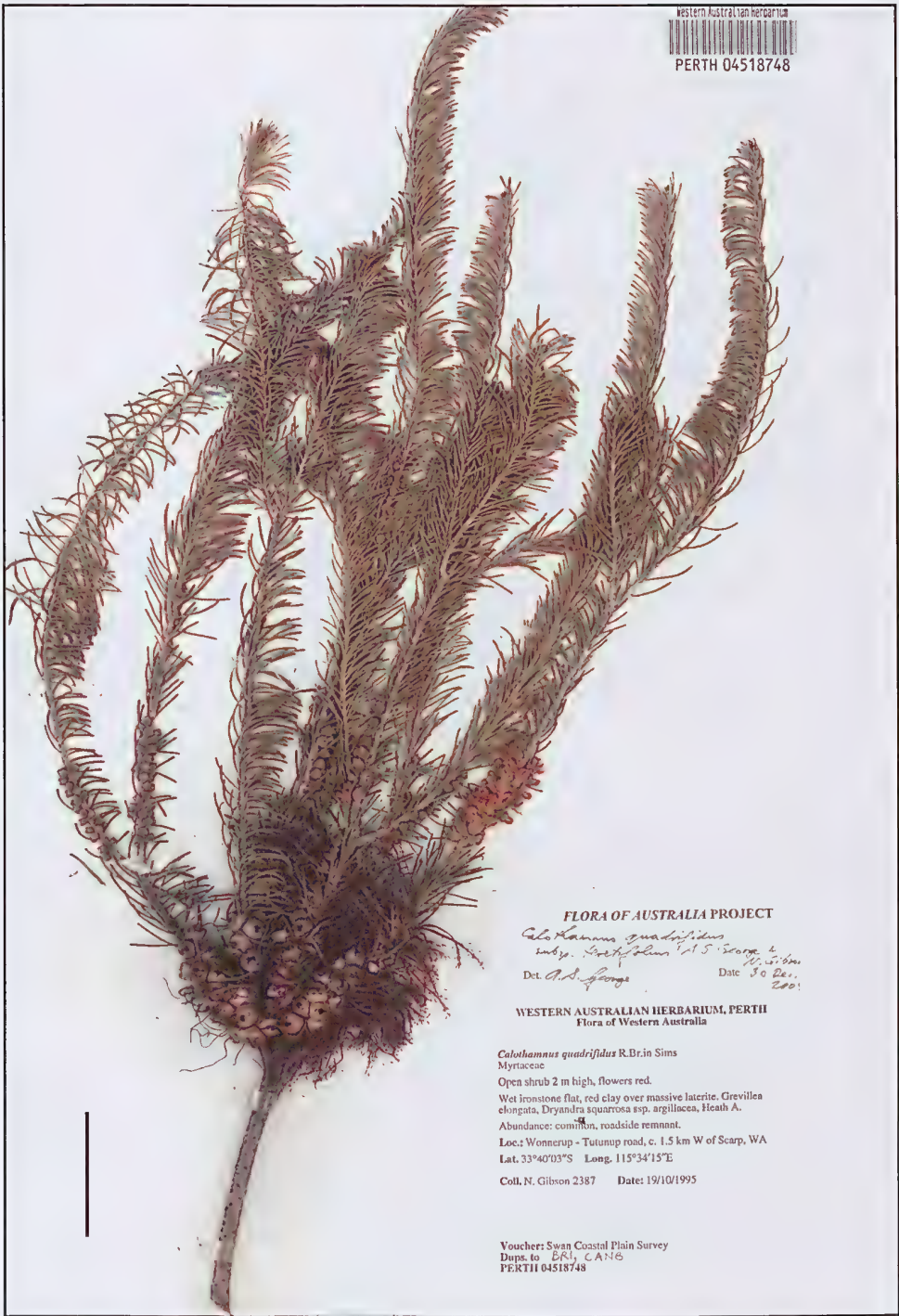


Figure 2. *Calothamnus quadrifidus* subsp. *teretifolius*. Holotype, west of [Whicher] Scarp, N. Gibson 2387 (PERTH 04518748). Scale bar = 5 cm.



*Etymology.* From the Latin *teres* (terete) and *folium* (a leaf).

*Notes.* This subspecies is typically glabrous. *D.B. Foreman* 1537 has sparse, spreading hairs on the young stems and a pubescent lower half of the hypanthium. *B.J. Keighery* 2207 from State Forest 12 (PERTH) has very sparse hairs on young stems and hairs at the very base of the hypanthium. *R.J. Cranfield* 17664 has pilose stems and the hypanthium is pubescent throughout but it is placed here on account of its slender terete leaves and locality.

A collection from west-north-west of Kojonup, *C.M. Lewis* 139A (PERTH), has terete leaves 0.4–0.5 mm wide, pilose when young, and a shortly pubescent hypanthium; it appears intermediate between subsp. *quadrifidus* and subsp. *teretifolius*.

### **b. *Calothamnus quadrifidus* subsp. *quadrifidus***

*Billotia acerosa* Colla, *Hortus Ripul.* 1: 20, t. 23 (1824); *Melaleuca acerosa* (Colla) G. Don, *Gen. Hist.* 2: 815 (1832); *Calothamnus quadrifidus* f. *acerosus* (Colla) Benth., *Fl. Austral.* 3: 180 (1867). *Type:* cultivated at Rivoli, Italy, from seed from Australia (*holo?*: TO, photo: PERTH).

*Calothamnus purpureus* Endl., *Enum. Pl.* 48 (1837) as *purpurea*. *Type:* near Fremantle, towards Swan River, Western Australia, November–December 1833, *C. Huegel s.n.* (*holo*: W).

*Calothamnus laevigatus* Schauer, *Regelia, Beaufortia, Caloth.* 30 (1843) as *laevigata*. *Type:* between King George Sound and Perth, Western Australia, February 1840, *L. Preiss* 215 (*lecto*: LD, *fide* T.J. Hawkeswood, *Nuytsia* 6: 118 (1987); *isolecto*: MEL 2290292, 2290293).

*Illustration.* Corrick & Fuhrer, *Wildfls Western Australia* 116 pl. 343 (2009).

*Shrub* to 3 m tall, sprawling or erect, with or without lignotuber. *Stems* pilose or pubescent, glabrescent. *Leaves* linear, commonly slightly wider above middle, to terete or almost so, obtuse to acute, 10–35 mm long, 0.5–1 mm wide, glabrous or almost so, or spreading-pilose when young, sometimes silky-pubescent (e.g. *B.A. Fuhrer* 96/104), glabrescent, then smooth or finely scabrid. *Hypanthium* 3.5–4 mm long, closely tomentose or pubescent, commonly only in lower half, at base only, or glabrous, pustulate. *Sepals* ciliate. *Staminal bundles* 22–35 mm long. *Fruit* 7–10 mm long, smooth to warted. (Figures 3, 4)

*Selected specimens examined.* WESTERN AUSTRALIA: Ellis Brook valley reserve, 18 Oct. 2000, *H. Bowler* 665 (PERTH); Stockyard Rd, W of Quindanning–Darkan Rd, 11 Dec. 1997, *R. Davis* 4767 (PERTH); Hill River Nature Reserve, 22 Sep. 1991, *W. Greuter* 22301 (B, PERTH); Yanchep National Park, 18 Nov. 1963, *A.M. James* 92 (PERTH); Mt Ragged, 31 Dec. 1984, *R.A. Kilgour* 492 (MEL, PERTH); Mt Burdett, 8 Nov. 1992, *A. Lyne* 1083 *et al.* (AD, BRI, CANB, MEL, NSW, PERTH); Reabold Hill, 26 Nov. 1971, *B.R. Maslin* 2306 (CANB, L, PERTH); Hassell Beach, 16 Nov. 1985, *A.N. Rodd* 4994 & *J. McCarthy* (NSW, PERTH); Red Hill, Toodyay Rd, 27 Oct. 1964, *R.A. Saffrey* 143 (PERTH); 72 km E of Lake Grace, 11 Nov. 1974, *D.J.E. Whibley* 5367 (AD, PERTH).

*Distribution and habitat.* Occurs from about Leeman and Lake Indoon to Mandurah and inland through Badgingarra, Dandaragan and along the Darling Scarp to Dwellingup; then inland through the central wheatbelt to Hyden, southwards to Albany and eastwards to Israelite Bay and inland to Peak Charles and Mt Ragged. Grows on coastal dunes and rocky calcareous soil, farther inland in sandy, granitic or lateritic soil in kwongan, tall shrubland, and eucalypt woodland. (Figure 1)



Figure 3. *Calothamnus quadrifidus* subsp. *quadrifidus*. Typical, south coast form. Lucky Bay, B.J. Conn 3424 & J.A. Scott (PERTH 01134752). Scale bar = 5 cm.



Figure 4. *Calothamnus quadrifidus* subsp. *quadrifidus*. West coastal form. Near Cervantes, E. Noble 74 (PERTH 05475988). Scale bar = 5 cm.



*Phenology.* Flowers mainly September–December.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Notes.* The indumentum on vegetative parts may appear silky when very young but the hairs spread widely when mature. The plants are usually lignotuberous but occasionally not, e.g. Mt Short, A.S. George 17662 (PERTH).

This is the most variable subspecies of *C. quadrifidus*. The following are the major variants that may, with further study, warrant formal recognition.

Typical subsp. *quadrifidus* occurs along the south coast between Hopetoun and Israelite Bay and a short distance inland. Farther inland the leaves are usually a little longer and often not widened upwards. West from Hopetoun, plants are commonly less hairy, especially in the hypanthium, and the leaves are more slender.

Plants from Bettys Beach and Cheyne Beach to Cape Riche have thick, crowded leaves that are glabrous but somewhat scabrid, but otherwise are glabrous except finely ciliate sepals. About 10% of the population at Bettys Beach on the coastal granite have yellow stamens (November 2002); elsewhere this colour form of *C. quadrifidus* is very sporadic.

Some specimens from Mt Ragged and other parts of Cape Arid National Park, e.g. D.B. Foreman 1306 (MEL, PERTH), A.N. Rodd 5182 (NSW, PERTH), have a pubescent hypanthium. Similar to these are specimens from islands of the Recherche Archipelago, e.g. Middle Island, A.S. Weston 9877 (CANB, PERTH).

Populations on and near Peak Charles are varied, most (e.g. D.E. Albrecht 4076, MEL, PERTH) having less hairy leaves and the hypanthium almost glabrous except a ring of hairs at the base, similar to subsp. *quadrifidus*, but others from the same locality (e.g. D.E. Albrecht 4075, MEL, PERTH) are similar in indumentum to subsp. *seminudus*.

Two collections from south-east of Frankland that are glabrous and have slender, terete leaves approach subsp. *teretifolius*. One, A.R. Annels 4349B (PERTH), was growing in gravelly clay on a valley floor, the other, A.R. Annels ARA 3894 (PERTH), was in yellow sand on a mid-slope. However other nearby collections (c. 500 m away), although variable, are clearly subsp. *quadrifidus* (N. Gibson (4645–4649) & M. Byrne, PERTH). Further collections from these areas would be useful.

Through the southern and central wheatbelt the leaves vary greatly in length and width, but within the dimensions given in the description.

On the Swan coastal plain, the leaves are usually more slender, sometimes almost terete. The hypanthium is glabrous, or hairy only at the base. Populations on the Darling Scarp and plateau also usually have slender leaves and have an either glabrous or shortly tomentose hypanthium. Some populations are mixed, e.g. one on Gobby Road, south of Serpentine, in which plants range from hairy throughout to almost glabrous. Northwards, the subspecies grades into subsp. *angustifolius* in having longer leaves, e.g. Marchagee Track, 45 km east of Brand Hwy, D.B. Foreman 493 (AD, CANB, MEL, PERTH).

Populations are scattered between the Darling Scarp and wheatbelt but they grade into wheatbelt forms of subsp. *quadrifidus*, e.g. Mercer Road Rock, west-south-west of York, *B. Wagner et al.* CJ 45 (PERTH); Wooroloo, *M. Koch* NSW 75126 (NSW, PERTH).

**c. *Calothamnus quadrifidus* subsp. *angustifolius*** (Ewart) A.S. George & N. Gibson, *stat. et comb. nov.*

*Calothamnus homalophyllus* var. *angustifolius* Ewart, *Proc. Roy. Soc. Victoria* ser. 2, 24 (1): 63 (1911). *Type*: central Greenough, Western Australia, September 1910, *M. Koch* 2086 (*holo*: MEL 2290291; *iso*: K).

*Illustration*. Erickson *et al.*, *Fls Pls Western Australia* 101 (1973) (as *Calothamnus homalophyllus*).

Erect to spreading *shrub* to 4 m tall, without lignotuber. *Leaves* narrowly obovate to linear, acute to pungent, 20–55(–85) mm long, 1–3 mm wide, glabrous, or silky when young, later glabrous, obscurely pustulate, smooth. *Hypanthium* 3 mm long, glabrous to minutely hairy; oil glands obscure. *Sepals* glabrous outside, tomentose inside. *Staminal bundles* 22–36 mm long. *Fruit* 6–10 mm long, smooth or warted. (Figure 5)

*Selected specimens examined*. WESTERN AUSTRALIA: 46.5 km E of Geraldton on Geraldton–Mullewa Rd, 9 Sep. 1997, *S. Donaldson* 1555 & *G. Flowers* (CANB, PERTH); Mingenew, 20 Aug. 1997, *B. Jack* 2 (PERTH); 17 km W of Morawa, 17 Aug. 1997, *F. Keast* M1A (PERTH); Ubin Rock, NW of Dowerin, 30 Apr. 2006, *L.A. Phillips* 13 (PERTH); Watheroo National Park, 7 Oct. 1971, *R.D. Royce* 9689 (PERTH); Cairn Hill, N of Moora, 23 Oct. 2000, *M. Trudgen* 21182 (PERTH).

*Distribution and habitat*. Occurs from Northampton to Dongara and Mullewa, southwards to Badgingarra and through the northern wheatbelt to Northam and Bruce Rock, in sand or loam with tall shrubland and kwongan. (Figure 1)

*Phenology*. Flowers August–November.

*Conservation status*. Not listed under DEC Conservation Codes for Western Australian Flora.

*Notes*. This and subsp. *homalophyllus* have the longest leaves of the *quadrifidus* complex. Some plants are glabrous e.g. north of Eneabba, Brand Highway, *J.M. Fox* 88/091 (PERTH); Trayning Reserve, *A. Chapman* 6 (PERTH). Leaves become shorter through the Moora–Calingiri region but are long and tending terete around Wongan Hills. From Mt Lesueur and Badgingarra southwards, and through the central wheatbelt (Goomalling to Northam and Bruce Rock), the subspecies grades into subsp. *quadrifidus* as the leaves become shorter and narrowly linear. Near-coastal plants have spreading (not silky) hairs on the new growth, e.g. Coorow–Greenhead Rd, Lesueur National Park, *G. Cassis et al.* 49-312 (PERTH). Two northern collections appear to be intermediate between subsp. *angustifolius* and subsp. *obtusius*, having narrowly obovate, shortly acute leaves 10–40 mm long and 1–3 mm wide: Balla–Whelarra Rd, 0.5 km north of junction with Ogilvie Rd East, *A.S. George* 17633 *et al.*, a single plant (PERTH); heading east to Matts Well, DH road reserve, *D.M. Porter* 287 (PERTH).

A collection from Mt Matilda, Wongan Hills (*M. Wheeler & L. Duffy* MW 28, PERTH), in fruit only, has most leaves 20–30 mm long but is placed here tentatively.



Figure 5. *Calothamnus quadrifidus* subsp. *angustifolius*. Casuarina–Mingenew road, B. Jack (PERTH 02329514). Scale bar = 5 cm.



**d. *Calothamnus quadrifidus* subsp. *homalophyllus*** (F. Muell.) A.S.George & N.Gibson, *stat. et comb. nov.*

*Calothamnus homalophyllus* F.Muell., *Fragm.* 3: 111 (1862) as *homalophylla*. Type: Red Point [Red Bluff?], Murchison River, Western Australia, 18--., *A. Oldfield* s.n. (*lecto*, here chosen: MEL 105185); Champion Bay, Western Australia, 18--., *P. Walcott*, s.n. (*syn*: MEL 105187, 105188).

*Calothamnus homalophyllus* var. *trachycarpus* F.Muell., *Fragm.* 3: 112 (1862) as *trachycarpa*. Type: none cited.

*Illustrations.* Erickson *et al.*, *Fls Pls Western Australia* 101 pl. 297 (1973); Corrick & Fuhrer, *Wildfls Western Australia* 115 pl. 339 (2009), both as *Calothamnus homalophyllus*.

Erect to spreading *shrub* to 5 m, without lignotuber. *Stems* glabrous. *Leaves* obovate, rounded-obluse, shortly mucronate, glabrous, or silky-pilose and soon glabrous, 30–50 mm long, 5–10(–14) mm wide. *Hypanthium* 3–5 mm long, glabrous; sepals 1–2 mm long, glabrous. *Petals* 4–5 mm long. *Staminal bundles* 27–32 mm long. *Pistil* 23–31 mm long. *Fruit* globose, 6–8 mm long, warted or smooth. (Figure 6)

*Selected specimens examined.* WESTERNAUSTRALIA: The Brothers, Moresby Range, 8 July 2000, *J. Brooker* 46 (PERTH); Yerina Springs Rd, c. 6 km N of Port Gregory Rd, 27 Sep. 1985, *J. D'Alonzo* 611 (CANB, PERTH); 32 km S of Northampton, 8 Sep. 1984, *D.B. Foreman* 593 (MEL, PERTH); Z Bend, Murchison R., Kalbarri National Park, 2 Oct. 1991, *W. Greuter* 22487 (PERTH); Eurardy Station, 30 Sept. 2007, *K.R. Thiele* 3398 (PERTH).

*Distribution and habitat.* Occurs from Eurardy Station and the lower Murchison River to Mingenew, Western Australia, in sand or sandy loam, often over sandstone, in kwongan and tall shrubland. (Figure 1)

*Phenology.* Flowers mainly August–November.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Notes.* Four sheets at MEL must be considered in the lectotypification of the name *Calothamnus homalophyllus*: MEL 105184, Murchison River, *A. Oldfield*; MEL 105185, Red Point [probably Red Bluff, Murchison River], *A. Oldfield*; MEL 105187, Champion Bay, *P. Walcott*; and MEL 105188, Champion Bay, collector not given. MEL 105187 and 105188 appear to be duplicates of the one collection; they have flowers but no fruit, and new growth that is glabrous or almost so. MEL 105184 has no flowers or fruit, and rather short leaves (showing a tendency towards subsp. *obtusus*). The best candidate is MEL 105185 which has broader leaves than the other collections, flowers and a single fruit that is smooth. Oldfield's label for this collection describes the plant as an 'upright shrub 4–5 ft' which fits Mueller's description 'Frutex 4–6' altus, erectus'. This was labelled holotype by Hawkeswood (1987). There is no sheet at MEL annotated by Mueller as var. *trachycarpus* and none that has flowers with three staminal bundles as he described (presumably one had fallen, as happens commonly).

Subsp. *homalophyllus* may be recognised by the large, obovate leaves and usually knobbly fruit. There are two variants, one with glabrous young shoots (represented by the lectotype), the other silky-pubescent becoming glabrous. Both variants occur in Kalbarri National Park but only the latter

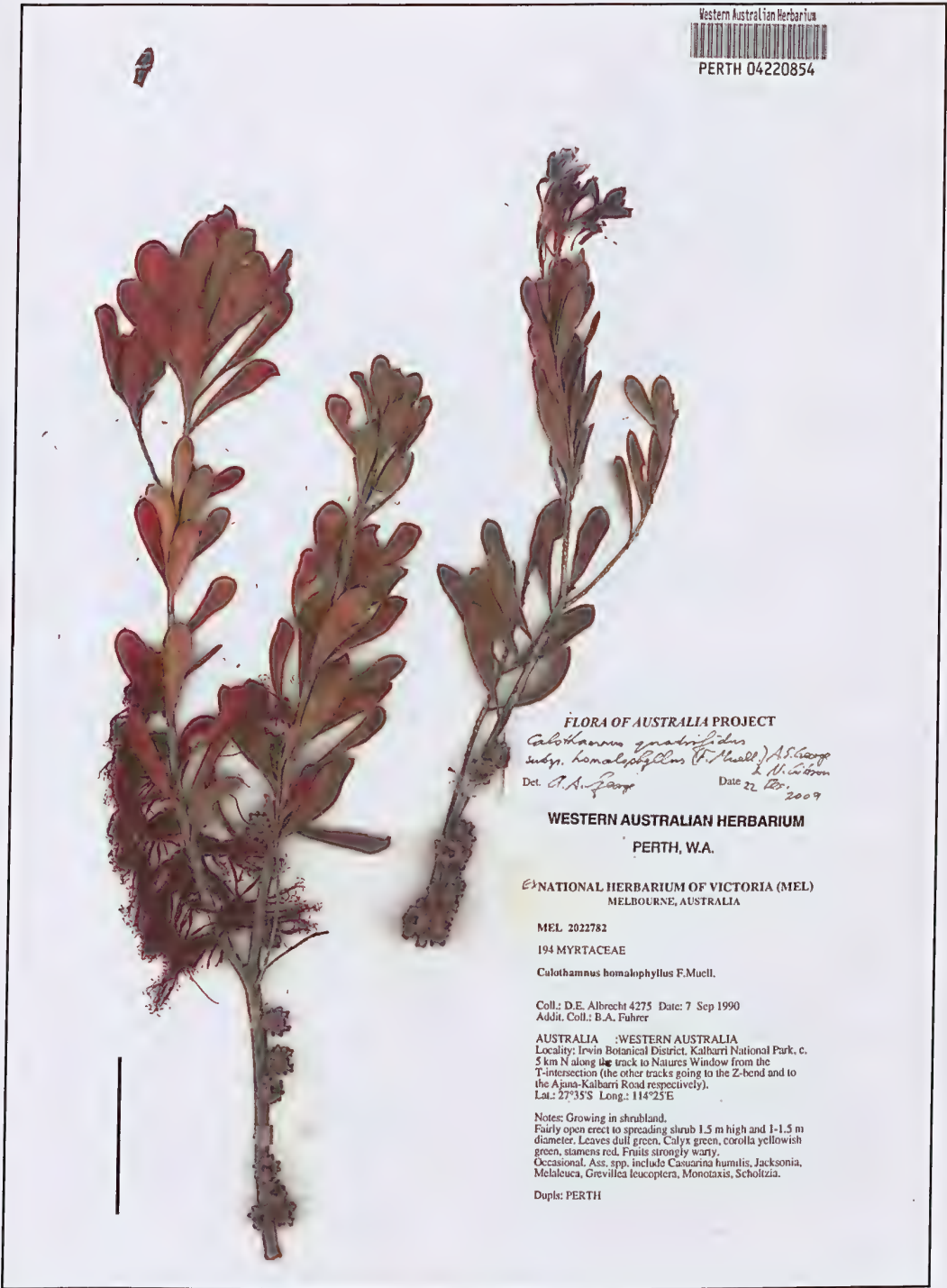


Figure 6. *Calothamnus quadrifidus* subsp. *homalophyllus*, c. 5 km along track to Natures Window, Kalbarri National Park, D.E. Albrecht 4275 & B.A. Fuhrer (PERTH 04220854). Scale bar = 5 cm.

around Ajana and Northampton. Although the taxon typically has distinctive, large, obovate leaves, it is variable in leaf form and grades into subsp. *angustifolius*; an intermediate collection is *c.* 33 km east of Geraldton on road to Mullewa, *A.R. Fairall* 1351 (PERTH). Some populations are variable, e.g. Yerina Springs Rd, represented by *A.S. George* 17613 *et al.* (PERTH), some plants having leaves 3–5 mm wide, others 2–3 mm wide. A collection from Eurardy Station (*Wildflower Soc. of Western Australia* EURA 67, PERTH) is placed here though its leaves are only 12–25 mm long; they are sparsely pubescent but glabrescent and smooth when mature.

**e. *Calothamnus quadrifidus* subsp. *obtusus* (Benth.) A.S.George & N.Gibson, *stat. nov.***

*Calothamnus quadrifidus* f. *obtusus* Benth., *Fl. Austral.* 3: 180 (1867). *Type:* Murchison River, Western Australia, 18–, *A. Oldfield* s.n. (*holo:* K; *iso:* MEL 105201, MEL 105202, OXF).

*Illustration.* Wrigley & Fagg, *Bottlebrushes Paperbarks Tea Trees* 131 (1993) as *Calothamnus homalophyllus*.

Erect or sprawling *shrub* to 3 m tall, with lignotuber. *Bark* coarsely fibrous. *Leaves* narrowly obovate to linear, obtuse, 10–35 mm long, 1–4 mm wide, pilose or hirsute when young, later finely scabrid, pustulate, sometimes smooth. *Hypanthium* 3–3.5 mm long, tomentose in lower half becoming almost glabrous towards summit, or  $\pm$  glabrous throughout, pustulate. *Sepals* glabrous except minutely ciliate margins. *Staminal bundles* 18–25 mm long. *Fruit* 6–10 mm long, glabrescent, smooth or warted. (Figure 7)

*Selected specimens examined.* WESTERN AUSTRALIA: track to Eagle Gorge, Kalbarri National Park, 6 Sep. 1990, *D.E. Albrecht* 4237 & *B. Fuhrer* (MEL, PERTH); Oakabella Nature Reserve, 14 June 2000, *A. Chant* 20 (PERTH); Useless Loop Rd, 12.3 km W of Overlander–Denham Rd, 13 Sep. 2004, *A.S. George* 17629, *R.K. Brummitt* & *E.G.H. Oliver* (CANB, K, MEL, NSW, PERTH); SW of Cooloomia HS, 20 Sep. 1979, *S.D. Hopper* 1410 (PERTH).

*Distribution and habitat.* Occurs from Tamala Station (south of Shark Bay) south to Kalbarri and the Mullewa area, in red or yellow sand, sometimes over sandstone, in kwongan, tall shrubland and low open woodland. (Figure 1)

*Phenology.* Flowers August–October.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Notes.* From the State Barrier Fence to the Murchison River, plants are commonly glabrous except a ring of hairs at the base of the hypanthium (and the disk within the flower). Hairy and glabrous plants can occur in the same population, e.g. 8 km east of Tamala HS, *M. Peterson*, 23 August 1979 (PERTH, 3 sheets). Near Red Bluff, Kalbarri National Park, there is a population that appears to be a hybrid swarm with this and subsp. *homalophyllus* as the original parents.

**f. *Calothamnus quadrifidus* subsp. *asper* (Turcz.) A.S.George & N.Gibson, *stat. et comb. nov.***

*Calothamnus asper* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 22: 25 (1849) as *aspera*. *Type:* southwestern Western Australia, 184–, *J. Drummond* 4: 60 (*holo:* KW; *iso:* BM, CGE, K, LE, OXF, P).



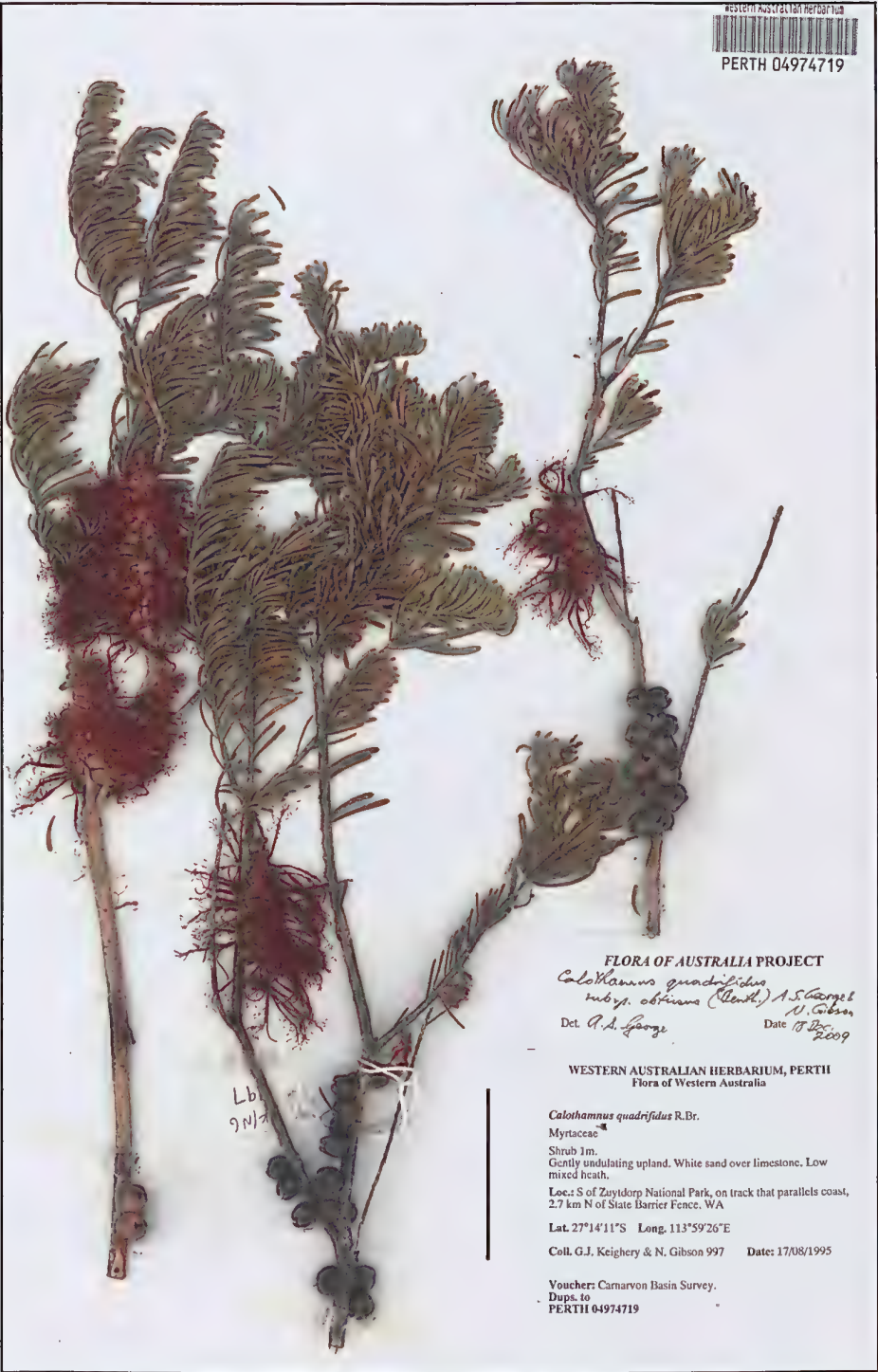


Figure 7. *Calothamnus quadrifidus* subsp. *obtusus*. South of Zuytdorp National Park, on coastal track 2.7 km north of State Barrier Fence, G.J. Keighery & N. Gibson 997 (PERTH 04974719). Scale bar = 5 cm

Erect *shrub* to 4 m, without lignotuber. *Stems* pilose, glabrescent. *Leaves* narrowly obovate or linear, acute to obtuse, shortly mucronate, 10–23 mm long, 1–2 mm wide, openly hirsute and scabrid, the long hairs wearing off. *Hypanthium* 4–6 mm long, glabrous but warted. *Staminal bundles* 23–28 mm long, deep red. *Pistil* 30–33 mm long. *Fruit* 10–14 mm long, smooth to coarsely warted, otherwise glabrous. *Seeds* 1.5–2 mm long, smooth. (Figure 8)

*Selected specimens examined.* WESTERN AUSTRALIA: Monks Well Gully, Wongan Hills, 17 Feb. 1984, T.J. Hawkeswood 159 (PERTH); NW of Wongan Hills (town), 1 Sep. 1980, K.F. Kenneally 7471 (PERTH).

*Distribution and habitat.* Confined to a small area in the Wongan Hills, on lateritic slopes or in shaly clay, in shrubland, sometimes with mallees. (Figure 1)

*Phenology.* Flowers August–September.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Notes.* Subspecies *asper* is recognised mainly by the clearly scabrid mature leaves and usually larger fruit. Geographically it is the most restricted subspecies of *C. quadrifidus*, and morphologically the least variable, but the morphology clearly places it with this species.

**g. *Calothamnus quadrifidus* subsp. *petraeus* A.S.George & N.Gibson, *subsp. nov.***

Ab subspeciebus aliis *Calothamni quadrifidi* foliis pilosis aetate scabridis, hypanthio tomentoso, sepalis tomentosis, differt.

*Typus:* Duladgin Rock, north of Yellowdine, Western Australia, 31° 10' S, 119° 41' E, 22 September 1969, A.S. George 9642 (*holo:* PERTH 02329387; *iso:* AD, CANB, K, MEL).

Erect to spreading *shrub* to 2.5 m tall, without lignotuber. *Leaves* crowded, linear, obtuse to acute, 10–23 mm long, 0.9–1.1 mm wide, pilose, remaining so when mature or glabrescent but scabrid. *Hypanthium* tomentose including sepals. *Petals* pubescent or glabrous. *Staminal bundles* 25–30 mm long. *Fruit* 10–11 mm long, at length glabrous. (Figure 9)

*Selected specimens examined.* WESTERN AUSTRALIA: McDermid Rock, W of Norseman, 8 Aug. 1999, B. Archer 1322 (MEL, NSW, PERTH); 36 miles [c. 62 km] NW of Southern Cross, 26 Nov. 1891, R. Helms (K); Chutawalakin Hill, NNE of Warralakin, 2 Aug. 1978, S.D. Hopper 1030 (PERTH); 23 km E of Karroun Hill, 1983, P. Roberts 233 (PERTH).

*Distribution and habitat.* Occurs from Karroun Hill south to Merredin, east to Yellowdine area and south-east to McDermid Rock, in granitic or quartzitic soil with tall shrubland. (Figure 1)

*Phenology.* Flowers August–October.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Etymology.* From the Greek *petraeus* (rocky), in reference to the occurrence on rock outcrops.



Figure 8. *Calothamnus quadrifidus* subsp. *asper*. Rogers Nature Reserve, Waddington–Wongan Hills road, A.S. George 17641, R.K. Brummitt & E.G.H. Oliver (PERTH 06996477). Scale bar = 5 cm.





Figure 9. *Calothamnus quadrifidus* subsp. *petraeus*. Holotype, Duladgin Rock, north of Yellowdine, A.S. George 9642 (PERTH 02329387). Scale bar = 5 cm.

*Notes.* The tomentose hypanthium and sepals and the pilose (later scabrid) leaves are diagnostic. It is common in the eastern wheatbelt, especially on granite, and southwards grades into subspp. *seminudus* and *quadrifidus*. This is the 'peculiar variety [of *Calothamnus asper*] with a pubescent calyx' from near Mt Churchman, mentioned by Mueller, *Fragmenta* 10: 31 (1876).

**h. *Calothamnus quadrifidus* subsp. *seminudus* A.S. George & N. Gibson, subsp. nov.**

Ad *Calothamnus quadrifidus* subsp. *petraeus* arcte affinis, a qua hypanthio in dimidio superiore glabro, sepalis glabris praeter margines ciliatos, et petalis glabris, differt.

*Typus:* c. 1 km east of Digger Rocks trig on track to Hatter Hill, Western Australia, 32° 43' 34.6" S, 119° 49' 37.1" E, 14 November 2005, *N. Gibson* 4633 & *M. Byrne* (*holo:* PERTH 08133719; *iso:* CANB, MEL).

Erect to spreading *shrub* to 2 m tall, without lignotuber. *Leaves* crowded, linear but slightly broadened upwards or very narrowly obovate, obtuse to acute, usually 10–20 mm long, 0.8–1.5 mm wide, pilose, glabrescent but scabrid. *Hypanthium* 3–4 mm long, tomentose with reflexed hairs in lower third to half, glabrous above including sepals except ciliate margins. *Petals* glabrous. *Staminal bundles* 25–28 mm long. *Fruit* 8–9 mm long, smooth or slightly irregular but not warted, glabrous. (Figure 10)

*Selected specimens examined.* WESTERN AUSTRALIA: near Hatter Hill, 9 Dec. 1964, *C.A. Gardner* 15911 (PERTH); Bremer Range, c. 8 km SSE of Mt Glasse, 14 Sep. 1994, *N. Gibson* & *M. Lyons* 1849 (PERTH).

*Distribution and habitat.* Occurs from the Ironcaps to Digger Rock, the Bremer Range and Peak Charles, in lateritic loam, in mallee shrubland, occasionally on granite. (Figure 1)

*Phenology.* Flowers August–December.

*Conservation status.* Not listed under DEC Conservation Codes for Western Australian Flora.

*Etymology.* From the Latin *semi-* (half) and *nudus* (bare), in reference to the hypanthium which is glabrous in the upper half to two-thirds.

*Notes.* This is readily distinguished from subsp. *petraeus* by the hypanthium which is tomentose only in the lower third to half, and the sepals which are usually glabrous outside but shortly ciliate. It has a more even habit than subsp. *petraeus* and the foliage is greener. The leaves are pilose but usually soon glabrescent, and sometimes scarcely scabrid.

A population at Ninety Mile Tank (*N. Gibson* 4650–4659 & *M. Byrne*, PERTH), is growing in deep yellow sand and is variable in its indumentum, from typically hairy to having hairy but glabrescent leaves that are sometimes wider (to 1.5 mm), and a hypanthium that is glabrous except a ring of hairs at the base.

A collection from Knapp Rock (*K.M. Allan* 779, PERTH) is intermediate between this and subsp. *petraeus*. The hypanthium is tomentose throughout and the sepals are shortly tomentose in some flowers but several on the same specimen are glabrous.



Figure 10. *Calothamnus quadrifidus* subsp. *seminudus*. Holotype, c. 1 km east of Digger Rocks trig on track to Hatter Hill, N. Gibson 4633 & M. Byrne (PERTH 08133719). Scale bar = 5 cm.



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## ***Stylidium* miscellany 1: typifications and new taxa from south-west Western Australia**

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### **Abstract**

Wege, J.A. *Stylidium* miscellany 1: typifications and new taxa from south-west Western Australia. *Nuytsia* 20: 79–108 (2010). The types of names relating to 24 species of *Stylidium* from south-west Western Australia are reviewed. Lectotypes are selected for *S. barleei* F.Muell., *S. breviscapum* var. *erythrocalyx* Benth., *S. ciliatum* Lindl., *S. ciliatum* var. *minor* Sond., *S. dispernum* F.Muell., *S. elongatum* Benth., *S. galioides* C.A.Gardner, *S. imbricatum* Benth., *S. lepidum* F.Muell. ex Benth., *S. limbatum* F.Muell., *S. miniatum* Mildbr., *S. piliferum* R.Br., *S. plantagineum* Sond., *S. preissii* (Sond.) F.Muell., *S. verticillatum* F.Muell. and *S. yilgarnense* E.Pritz. Neotypes are nominated for *S. pritzelianum* Mildbr., *S. pseudocaesпитosum* Mildbr. and *S. stenosepalum* E.Pritz. *Stylidium piliferum* subsp. *minor* (Mildbr.) Carlquist is lectotypified and placed into synonymy under *S. piliferum*. *Stylidium elegans* J.Drumm. is newly established as a synonym of *S. plantagineum* and a lectotype designated. *Stylidium involucratum* F.Muell. is reinstated and *S. stowardii* M.B.Scott placed into synonymy. The collector of the type of *S. glaucum* (Labill.) Labill. is confirmed as Leschenault de la Tour. *Stylidium thesioides* DC. is reinstated and *S. canaliculatum* Lindl., an earlier but illegitimate name, is placed into synonymy. *Stylidium scandens* R.Br. is lectotypified and *S. nymphaeum* Wege, a species collected by Robert Brown in 1801 and drawn by Ferdinand Bauer, is newly described. *Stylidium spathulatum* R.Br. subsp. *acuminatum* Carlquist is raised to species level and *S. acuminatum* subsp. *meridionalis* Wege newly described. *Stylidium glaucum* subsp. *angustifolium* Carlquist is similarly raised to species level, whilst *S. luteum* subsp. *glaucifolium* Carlquist retained as a subspecies but transferred to *S. angustifolium* (Carlquist) Wege.

### **Introduction**

Ongoing taxonomic work on *Stylidium* Sw. (Stylidiaceae) has revealed that a significant number of typifications are needed prior to completion of the *Flora of Australia* account of the genus. This paper serves to review the types of names relating to 24 species from southern Western Australia and includes descriptions for five new names.

### **Methods**

This study is based upon field observations; the examination of material housed at PERTH and study of type specimens housed at various national and international herbaria. Herbarium abbreviations



follow *Index herbariorum* (Thiers, continuously updated). Vegetative characters were measured from herbarium material and floral features mostly measured from the following spirit collections (*J.A. Wege* numbers unless otherwise indicated): *S. acuminatum* (Carlquist) Wege subsp. *acuminatum* – 1250; *S. acuminatum* subsp. *meridionalis* Wege – 782, 785, 793, 811, 823, 1165, 1172; *S. angustifolium* (Carlquist) Wege subsp. *angustifolium* – 1569, 1571, 1574, 1575; *S. angustifolium* subsp. *glaucifolium* (Carlquist) Wege – 1123, 1133, 1176, 1500, 1565; *S. nymphaeum* Wege – 865, 866, 870, *C. Tauss* CT 3-10. Geographic regions follow *IBRA Version 6.1* (Department of the Environment, Water, Heritage and the Arts 2008).

### Typifications

**Stylidium barleei** F.Muell., *Fragm.* 6: 5, t. XLIX (1867). *Candollea barleei* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘In Australia occidentali detexit. *J. Drummond* ... inventore sub numeris 274 et 329 [129] distribute ...’ *Lectotype*: Western Australia, *s. dat.*, *J. Drummond* 274 (here designated: MEL 2069476!; *islectotypes*: BM!, CGE!, E!, G!, K 00355037!, K 000355038!, LD 1097476!, OXF!, P!, W!). *Paralectotype*: Western Australia, *s. dat.*, *J. Drummond* 129 (K 000060585! MEL 2069475!).

*Typification*. MEL 2069476 is selected as an appropriate lectotype of *S. barleei* since it closely resembles the illustration provided by Mueller and bears his annotation. A Drummond *Stylidium* collection with the number 329 has not been located despite extensive searches at a range of Australian and international herbaria. This number is thought to be a typographical error since the MEL sheet of *J. Drummond* 129 was viewed by Mueller.

**Stylidium breviscapum** R.Br., *Prodr. Fl. Nov. Holland.*: 572 (1810). *Candollea breviscapa* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v.v. flor. emarcid.’ *Type specimen*: Bay I South Coast [Lucky Bay, Cape Le Grand, Western Australia, January 1802], *R. Brown* Bennett No. 2608 (*holotype*: BM!).

*Stylidium breviscapum* var. *erythrocalyx* Benth., *Fl. Austral.* 4: 31 (1868). *Type citation*: ‘Fitzgerald Ranges and Cape Arid, Maxwell.’ *Lectotype*: ‘S West end Cape arid Range’, [Western Australia], *s. dat.*, *G. Maxwell s.n.* (here designated: MEL 2046601!; *islectotype*: K 000060836!). *Paralectotype*: Fitzgerald Ranges, *s. dat.*, *G. Maxwell* 150 (BM!, MEL 672624!), = *S. involucrellum*.

*Typification*. Whilst the type of *S. breviscapum* bears immature fruit rather than flowers, there is no doubt as to the application of this name. Lowrie *et al.* (1999: 101) designated the BM sheet as the lectotype, however, I am not aware of any duplicate material and therefore I have treated this sheet as the holotype.

Upon describing *S. breviscapum* var. *erythrocalyx*, Benth (1868) cited two gatherings by Maxwell that are referable to two different species: *S. breviscapum* (from Cape Arid) and *S. involucrellum* F.Muell. (from the Fitzgerald Ranges, see under *S. involucrellum* below). To fix the application of this varietal name, MEL 2046601 from Cape Arid, which was viewed by Benth, is designated as a suitable lectotype since it seems a closer match to Benth’s description (‘Inflorescence not so dense. Peduncles or scapes less hairy’). Interestingly, Benth stated that Brown’s collection of *S. breviscapum* is very near his new variety. This statement is best explained upon consideration of the remaining specimens cited by Benth under *S. breviscapum*, which are all referable to *S. eriopodum* DC.

K 000060836 originated from Mueller's herbarium and bears the annotation 'Cape Arid and Fitzgerald Ranges' in Bentham's hand. The fragments match Maxwell's Cape Arid collection of *S. breviscapum* and not his Fitzgerald Ranges collection of *S. involucratum*, and are therefore interpreted here as duplicate material of the lectotype of *S. breviscapum* var. *erythrocalyx*. I mistakenly annotated this sheet as type material of *S. involucratum* in 2006. This sheet was also annotated by Burbidge in 1985 as a lectotype of *S. breviscapum* var. *erythrocalyx*, however, this lectotypification was never published.

***Stylidium ciliatum*** Lindl., *Sketch Veg. Swan R.* xxviii (1 December 1839); *Candollea ciliata* (Lindl.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882); *Stylidium piliferum* var. *ciliatum* (Lindl.) Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 71 (1908). *Type*: not cited [Swan River, Western Australia, 1835–1838, *J. Drummond s.n.*] (*lectotype, here designated*: CGE!; *isolectotypes*: CGE!, FI 113117!, G-DC!, K 000060728!, M!).

*Stylidium setigerum* DC., *Prodr.* 7(2): 782 (late December 1839). *Type*: 'in Novâ-Hollandiâ ad Swan-river', [Western Australia 1835–1838], *J. Drummond s.n.* (*holotype*: G-DC!; *isotypes*: CGE!, FI 113117!, K 000060728!, M!).

*Stylidium ciliatum* var. *minor* Sond. [published as *β minor*], in Lehm., *Pl. Preiss.* 1(3): 374 (1845). *Type*: In lapidosis montis Barker vel Bokkenbop, Plantagenet, [Western Australia], October 1840, *L. Preiss* 2266 (*lectotype, here designated*: MEL 293336; *isolectotypes*: G!, LD!, P 00313119!).

*Typification.* There are two sheets of *S. ciliatum* at CGE that were viewed by Lindley, one of which was retained in his personal herbarium while the other was donated to the herbarium of C.M. Lemann. Both agree with Lindley's protologue. The specimen retained in Lindley's herbarium has been selected here as the lectotype. De Candolle's *S. setigerum* was published shortly after *S. ciliatum* and is based upon the same Drummond gathering, acquired as part of his first unnumbered series from between Perth to Toodyay and Mogumber, including an area of sandplain scrub (or Guangan) near Bolgart (Erickson 1969; Maslin & George 2004). The designated lectotype of *S. ciliatum* var. *minor* is from Sonder's herbarium and includes a dissected flower in a packet that was used by Sonder to compile his description.

***Stylidium dispernum*** F.Muell., *Fragm.* 4: 93 (1864); *Candollea disperma* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: 'In locis humidiusculis glareosis collium ad flumen Murchison River; Oldfield.' *Lectotype*: near the Murchison River, [Western Australia], *s. dat.*, *A.F. Oldfield s.n.* (*here designated*: MEL 293339!; *isolectotypes*: K 000060577!, MEL 2156168!, ?MEL 2156171!). *Paralectotype*: Gravelly hill near Oolingarra, Murchison, Western Australia, *s. dat.*, *A.F. Oldfield* 901 (MEL 2156167!).

*Typification.* Several relevant Oldfield specimens have been located. MEL 293339 has been chosen as an appropriate lectotype since it is a flowering collection (the paralectotype is sterile) that conforms to Mueller's description and bears both his annotation and Oldfield's field slip. The slip reads: 'Petals white with a purple spot n[ea]r the base' with the locality given on the reverse as '... near the Murchison River.' K 000060577 was received by the Royal Botanic Gardens Kew from Mueller in 1867 and so is likely to have been used in part by Mueller to write his description. It is comparable to the lectotype in terms of flowering time and plant size and so is treated here as duplicate material.

MEL 2156168 is labelled by Mueller as being from the Murchison River and although the collector is not indicated, I interpret it as an Oldfield collection. Bentham viewed this sheet whilst preparing his *Stylidium* treatment for *Flora Australiensis* and thus it must have collected prior to 1868. James

Drummond is not known to have collected this species and Mueller did not visit the Murchison district until 1877 (Churchill *et al.* 1978). The specimen is fragmentary, comprising inflorescence and leaf fragments; however, it appears comparable to the lectotype and is treated here as duplicate material. MEL 2156171 is a complete specimen with the same label information as MEL 2156168; however, it was not seen by Bentham. This specimen is therefore treated as a possible duplicate of the Oldfield collection. Only one collection of *S. dispersum* by Mueller is known, gathered in November 1877 from the Upper Irwin's River (MEL 2156170).

MEL 293340 and MEL 2156169 were collected by Oldfield from the Murchison River; however, these specimens are annotated by Mueller as the unpublished variety *S. dispersum* var. *humile* and therefore I do not interpret them to represent type material of *S. dispersum*. Like many species of *Stylidium*, individual plant size can be variable both within and between populations and is not considered in this case to be taxonomically significant.

***Stylidium elongatum*** Benth., *Fl. Austral.* 4: 11 (1868); *Candollea elongata* (Benth.) F.Muell., *Syst. Census Austral. Pl.*: 85 (1882); *S. crassifolium* subsp. *elongatum* (Benth.) Carlquist, *Aliso* 7(1): 60 (1969). *Type citation*: 'Drummond; Champion Bay, Oldfield.' *Lectotype*: Champion Bay, [Western Australia], *s. dat.*, A.F. Oldfield 734 (here designated: MEL 2295765!). *Paralectotype*: W.A. [Western Australia], *s. dat.*, [J. Drummond *s.n.*] (MEL 2258789!).

*Typification.* No type material of *S. elongatum* has been found at K; however, two relevant sheets have been located at MEL. The first of these, MEL 2258789, is fragmentary, consisting of a stem stock with leaves and the lower portion of the scape, the flowering portions of two individual scapes, and an envelope containing leaf fragments. Mueller has annotated the label with the locality 'W.A.' but no indication of the collector is given. Bentham viewed this material—the initial B is evident on the folded corner of the label—and he cited it as a Drummond gathering. James Drummond is known to have travelled to Champion Bay in 1852 as part of his 6th collection between 1850 and 1851 (Maslin & George 2004) and could have made the collection at this time. In view of the apparent lack of duplicate material, it is possible that MEL 2258789 was part of Drummond's personal reference set that was later acquired by MEL. This collection also bears a separate label with the annotation 'This is the original plant' which appears likely to be Drummond's handwriting (Alex George, pers. comm.).

The second sheet in question, MEL 2258789, is once again fragmentary, comprising five mounted plant portions (two stem stocks, two  $\pm$  sterile scape portions, and one flowering scape portion) and an envelope containing leaf and scape fragments as well as two stem stocks. There are two slips of paper with Oldfield's annotations: one cites the collection number (734), the other the same collection number and a brief plant description ('tufts, fl. red') and locality statement ('nr Champion Bay'). I have chosen this collection as the lectotype of *S. elongatum* since there is no ambiguity over the collector and specific locality information is provided. Interestingly, there are two Mueller labels each bearing Mueller's hand and each with the initial B on the folded corner. It is therefore possible that there are two separate gatherings represented on the sheet, a notion that is perhaps supported by the presence of numerous stem bases. However, it is also plausible that all portions on the sheet represent a single gathering and furthermore, in view of the clump-forming habit of this species, they could potentially have been sampled from a single individual. Since all of the fragments belong to the one species, and no fragments disagree with Bentham's protologue, the entire sheet is designated as the lectotype. This is a pragmatic solution since it would be impossible to accurately assign each fragment, and choosing one fragment as a lectotype would reduce the taxonomic information.

Bentham (1868) noted a second *Drummond* collection (*n.* 170: K 000355125, MEL 2156058) as comparable to *S. elongatum* 'but with a shorter, looser panicle'. This collection is referable to *S. yilgarnense* E.Pritz.



***Stylidium galioides*** C.A. Gardner, *J. Roy. Soc. W. Australia* 27: 198 (1942). *Type*: East Mount Barren, Western Australia, 26 November 1931, C.A. Gardner 2955 (*lectotype*, here designated: PERTH 01008102!; *isoelectotypes*: PERTH 01008145!, PERTH 01008129!, PERTH 01008110!, PERTH 01008137!).

*Typification*. PERTH 01008102 has been selected as the lectotype since it is the only type sheet that has been annotated by Gardner. It also bears sketches of the flowers. Gardner described the flowers of *S. galioides* as having two anterior throat appendages and six posterior appendages, and his drawings on the lectotype match this description; however, my observations on this species indicate that it has only four posterior throat appendages (two on each posterior corolla lobe). The number of appendages on the type material could not be confirmed without damaging the material.

***Stylidium glaucum*** (Labill.) Labill., *Nov. Holl. Pl.* 2: 64, t. 214 (1806). *Candollea glauca* Labill., *Ann. Mus. Hist. Nat.* 6: 454, t. 64, Figure 1 (1805). *Type citation*: ‘Habitat in terrâ Van-Leuwin’. *Type specimen*: King George Sound, [Western Australia], Feb. 1803, J.B. Leschenault de la Tour s.n. (*holotype*: FI 113130!; *isotype*: G!).

*Typification*. The type of *S. glaucum* could not have been collected by Labillardière since the species occurs well west of Esperance Bay, his only south-west landfall. Nelson (1974; 1975) correctly suggested that Labillardière, who is known to have used Australian collections other than his own, based his description on a collection by Leschenault de la Tour. Leschenault, who was part of the expedition aboard the *Géographe* and *Naturaliste* under Baudin, called at King George Sound from mid February to March 1st 1803 and is known to have made collections at this time (Nelson 1975). The holotype of *S. glaucum* bears the annotation ‘Habitat in terra van-Leuwin’ and the additional note ‘port du roi georges’ [King George Sound]. A specimen at G, which I interpret as an isotype, is similarly labelled as having been collected from ‘port du roi georges’ and bears the additional annotation ‘1803, M. Leschenault de la Tour’. *Stylidium glaucum*, which occurs in winter-wet habitats, is one of only a handful of triggerplants that would have been flowering in the Albany region during Leschenault’s summer visit.

***Stylidium imbricatum*** Benth., *Enum. Pl.* [Endlicher]: 73 (1837). *Candollea imbricata* (Benth.) F. Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type*: King Georges Sound, [Western Australia], s. dat., K.A.A. von Hügel s.n. (*lectotype*, here designated: W!; *isoelectotype*: MEL 710000! [fragment in envelope]).

*Typification*. Lowrie & Kenneally (1997: 354) recorded the holotype of *S. imbricatum* as being at K and gave the locality statement as ‘Interior of King George Sound’; however, I have been unable to locate a Hügel collection of *S. imbricatum* at K. It seems likely that an error has been made since there is a collection of this species at K made by Alexander Collie from the ‘Interior of King George Sound’ (K 000355185).

There is relevant Hügel material at both W and MEL. The W specimen comprises a stem portion with several inflorescences and a label in Bentham’s hand. I do not know whether Endlicher sent this material to Bentham in London or whether Bentham examined the specimens on a visit to Vienna. The MEL sheet has a pencil sketch of the plant portion at W plus a packet containing a stem portion and three flowers (presumably fragments from the W specimen). Both the packet and the drawing are annotated by Bentham. This MEL sheet also bears a separate collection of *S. imbricatum* by Harvey which is not type material. I have designated the W sheet as a suitable lectotype of *S. imbricatum*.

since it is the more complete specimen. I mistakenly annotated this specimen as an isoelectotype during my visit to Vienna in 2003. Curiously, the timing of Hügel's stay at King George Sound, from 1–11 January 1834 (Clark 1994), does not correspond to our understanding of the flowering time of *S. imbricatum*. Flowering specimens at PERTH have been collected from late February to October, with the majority of records from Autumn (April and May).

***Stylidium involucratum*** F.Muell., *Fragm.* 1: 154 (1859). *Stylidium breviscapum* var. *involucratum* (F.Muell.) Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 92 (1908). *Type*: 'In montibus Fitzgerald Range' [Western Australia], *s. dat.*, G. Maxwell 150 (*holotype*: MEL 672624!; *isotype*: BM!).

*Stylidium stowardii* M.B.Scott, *Bull. Misc. Inform. Kew* 1915(2): 91. *Lectotype*, *fide* Lowrie *et al.* (1999: 109): Nangeenan, Western Australia, December 1914, *F. Stoward* 121 (K 000060897!). *Paralectotype*: between Perth and Coolgardie, railway between Cunderdin and Dedari, Western Australia, October 1903, G.H. Thistleton-Dyer 87 (K 000060898!).

*Typification.* I recently examined the holotype of *S. involucratum* and found that it is not comparable to *S. breviscapum* R.Br. as interpreted by Lowrie *et al.* (1999: 101), but an earlier name for *S. stowardii* M.B.Scott, a species reinstated by Lowrie *et al.* (1999: 109). Historical triggerplant specimens are often difficult to interpret; however, a number of diagnostic features are clearly evident on the type of *S. involucratum*: the calyx lobes are unequal in length and with somewhat rounded apices; the anterior corolla lobes are less than half the length their posterior counterparts; the posterior corolla lobes are prominently falcate; and the labellum does not have lateral appendages. These features are all characteristic of *S. stowardii*. In contrast, *S. breviscapum* has sepals that are of more or less equal length and with subacute to acute apices; anterior corolla lobes that are shorter than the posterior pair but are not less than half their length; posterior corolla lobes that are only slightly falcate; and a labellum with prominent lateral appendages.

The type of *S. involucratum* was collected from the 'Fitzgerald Ranges' by George Maxwell, who is known to have traversed widely in what is now the Fitzgerald National Park region (Peter Olde, pers. comm.). *Stylidium involucratum* is known from this region, with specimens having been collected from within Fitzgerald River National Park (e.g. PERTH 02854813) as well as the Ravensthorpe Range (e.g. PERTH 06107788, PERTH 05284619). *Stylidium breviscapum* is also known from the area, occurring on East Mt Barren (e.g. PERTH 03178846), the Eyre Range (e.g. PERTH 01875167), Whoogarup Range (e.g. PERTH 02854821), and the Ravensthorpe Range (e.g. PERTH 06933017, PERTH 07355513). Maxwell is known to have made collections of a range of plant species from East Mount Barren, Middle Mount Barren and West Mount Barren, but he labelled them as such (Peter Olde, pers. comm.). It therefore seems unlikely that his locality of 'Fitzgerald Ranges' corresponds to the 'Mt Barren Ranges' as interpreted by Lowrie *et al.* (1999: 101).

***Stylidium lepidum*** F.Muell. ex Benth., *Fl. Austral.* 4: 27 (1868); *Candollea lepidum* (F.Muell. ex Benth.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: 'W. Australia, Drummond, n. 114, 3rd Coll. n. 181; Tone and Blackwood Rivers, Oldfield.' *Lectotype*: Tone River, Western Australia, *s. dat.*, A.F. Oldfield 271b (*here designated*: MEL 293363!; *isoelectotype*: K 000060803!). *Paralectotypes*: Western Australia, *s. dat.*, J. Drummond 114 (MEL 293359B!); Western Australia, *s. dat.*, J. Drummond 181 (FI!, GI!, K 000060802!, MEL 293359A!, NSW!, PI!, TCD!); Western Australia, *s. dat.*, J. Drummond s.n. (MEL 293433!); Blackwood River, Western Australia, *s. dat.*, A.F. Oldfield 271c (K 000060803!, MEL 293362!).

*Typification.* Mueller provided this species with its name as evidenced by his annotations on all of the MEL sheets cited above; however, the species was formally described by Bentham, who attributed the name to Mueller. All of the above cited sheets were viewed by Bentham and all are in agreement with his description. MEL 293363A has been selected as the lectotype since it is a good quality collection with locality information and duplicate material at K. Oldfield recorded the habitat of this collection as ‘wet places’ and noted the flowers are flesh-coloured. There are two additional Oldfield collections from the Tone River housed at MEL (*A.F. Oldfield* 271d, MEL 293361A and *A.F. Oldfield* 271e, MEL 293361B). These sheets were not viewed by Bentham and are therefore not accepted here as type material.

***Stylidium limbatum*** F.Muell., *Fragm.* 10: 57 (1876); *Candollea limbata* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type*: [Queen] Victoria Spring[s], [Western Australia], October 1875, *J. Young s.n.* (lectotype, here designated: MEL 242995!; isoelectotype: K 000060891!).

*Typification.* Young’s gathering is represented in the collections at both MEL and K. The latter specimen was received by the Royal Botanic Gardens Kew in December 1886 and so was likely to have been used in part by Mueller to write his description. Both sheets bear annotations by Mueller and are comparable to his description. The MEL sheet has been selected as a lectotype since it was the sheet retained by Mueller.

***Stylidium miniatum*** Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 69–70 (1908). *Type citation*: ‘West-Australien: Ohne Standort (Drummond II. Coll. n. 277!); Distr. Avon: Melbourne, Hügel am Moore River östlich bei Mogumber zwischen Gebüsch auf lehmigkeisigem Boden ca. 175 m ü. M. (blühend Ende August 1901 – Diels n. 4031!, E. Pritzel n. 581!).’ *Lectotype*: In fruticetis Moore River, [Western Australia], August 1901, *E. Pritzel* 581 (here designated: W!; isoelectotype: BM!, E! G!, K 000355138! M!, NSW!, P!, PERTH 01641565!). *Paralectotypes*: Moore River östlich bei Mogumber zwischen Gebüsch auf lehmigkeisigem Boden ca. 175 m ü. M.; August 1901, *L. Diels* 4031 (B, n.v., destroyed in WWII); Western Australia, s. dat., *J. Drummond* 277 (BM!, CGE!, E!, K 000060915!, K 000060917!, LD!, MEL 2295036! W!); Distr. Avon: Melbourne, s. dat., *K.A.A. von Hügel s.n.* (B, n.v., destroyed in WWII).

*Typification.* The type material viewed by Mildbraed at B was destroyed in WWII (Botanical Museum Berlin-Dahlem 1999), except for some fragments of *E. Pritzel* 581 that were acquired by Charles Gardner for the PERTH collection during his terms as Australian Botanical Liaison Officer (Green 1990). Whilst I have not located any duplicates of Diels’ or Hügel’s collections, I have seen numerous sheets of the Drummond and Pritzel gatherings, including specimens at W which have been annotated by Mildbraed as ‘*S. laterilium* Mildbr. n. sp.’, an earlier manuscript name for this species. Both the Drummond and Pritzel gatherings match the description provided by Mildbraed; however, the latter is preferable for lectotype designation since its provenance is known. I have selected the W sheet as the lectotype since it is a better quality specimen than that at PERTH.

***Stylidium piliferum*** R.Br., *Prodr. Fl. Nov. Holland.*: 569 (1810). *Candollea pilifera* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v.v.’ *Type specimen*: King George III’s Sound, [Western Australia], December 1801, *R. Brown Bennett* No. 2583 (lectotype, here designated: BM!; isoelectotypes: BM!, E!, K 000060745!).

*Stylidium piliferum* subsp. *minor* (Mildbr.) Carlquist, *Aliso* 7(1): 40 (1969). *Stylidium piliferum* var. *minor* Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 71 (1908). *Type citation*: West-Australien: King



Georges Sound (R. Brown!); Kent, Hammersley River, auf Sand zwischen lichtem Gebüsch, ca. 250 m ü M. (Blühend im Oktober 1901 – Diels n. 4931). *Lectotype*: King George's Sound, [Western Australia], R. Brown Bennett No. 2583 (*here designated* BM; *isolectotypes*: BM, E!, K 000060745!). *Paralectotype*: Kent, Hammersley River, October 1901, L. Diels 4931 (B, n.v., destroyed in WWII). *Stylidium saxifragoides* Lindl., *Sketch Veg. Swan R.* xxviii (1839). *Type*: not cited [Swan River, Western Australia, s. dat., J. Drummond s.n.] (*holotype*: CGE!; *isotype*: K000060754!).

*Typification*. Specimens of Robert Brown's gathering of *S. piliferum* have located at BM, E and K; all have the small stature typical of this species in the southern part of its range in south-west Western Australia. The sheet at BM with the most individuals and bearing Brown's field slip has been selected as a suitable lectotype.

Brown's collection of *S. piliferum* is one of two gatherings cited by Mildbraed in his protologue of *S. piliferum* var. *minor*. It is likely that Mildbraed viewed a duplicate at B which was subsequently destroyed in WWII (Botanical Museum Berlin-Dahlem 1999). The second syntype, a Diels' collection, was similarly destroyed and duplicate material has not been located. The lectotype of *S. piliferum* has therefore also been selected as a suitable lectotype of *S. piliferum* var. *minor*. Mildbraed's variety was raised to subspecific level by Carlquist (1969), who considered it to represent 'a dwarf race of this species'; however, he failed to consider the relevant type gatherings.

*Stylidium saxifragoides* Lindl. is tentatively placed here as synonym of *S. piliferum* pending further taxonomic study. The type, collected by Drummond as part of his first unnumbered series, originates from between Perth to Toodyay and Mogumber, including an area of sandplain scrub near Bolgart (Erickson 1969; Maslin & George 2004). The *S. piliferum* complex contains a number of new Western Australian taxa and is presently undergoing revision by Allen Lowrie and Kevin Kenneally.

***Stylidium plantagineum*** Sond., in Lehm., *Pl. Preiss.* 1(3): 371 (1845). *Type*: 'In glareoso-lapidosis umbrosis silvae ad clivulum inter Kaudiup et Two Peopled Bay, Plantagenet', [Western Australia], 24 November 1840, L. Preiss 2298 (*lectotype, here designated*: MEL 2156187!; *isolectotype*: FI!, L, LD!, M!, MEL 2156186!, MEL 2156188!, MEL 2156189!, TCD!, W!).

*Stylidium elegans* J.Drumm., Hooker's *J. Bot. Kew Gard. Misc.* 1: 376 (1849). *Type citation*: 'During my late journey to the south, I gathered a most exquisite *Stylidium* in flower.' *Lectotype*: Swan River [Western Australia, 1843], J. Drummond 3: 79 (*here designated*: K 000060253!; *isolectotype*: K 000355009!).

*Typification*. MEL 2156187 has been selected as an appropriate lectotype of *S. plantagineum* since it is part of Sonder's herbarium and bears descriptive information in Sonder's hand along with a packet containing a dissected flower used by him to compile his description.

*Stylidium elegans* was described by James Drummond in a letter written to William Hooker on February 21st 1844, and published in 1849 in Hooker's *Journal of botany and Kew Gardens miscellany*. Drummond wrote:

'During my late journey to the south, I gathered a most exquisite *Stylidium* in flower. For several years I had observed its foliage; but a careful examination of the plant in various situations lead me to the conclusion that the inflorescence is never produced in perfection, except on the second year after the ground has been cleared by fire. The leaves, which shoot up very beautifully, become hard and rigid in the course of two or

three years, and seem incapable of supplying the nutrient necessary to enable the plant to form its flowers and to mature its seeds. I have named it *S. elegans*: its roots are thick and fibrous; the leaves 18 inches long, lanceolate, smooth, and silky; the flowers are rose-coloured, and borne on stalks from a foot and a half to two feet high: on the whole, I consider it to be the finest species of the genus.'

*Stylidium elegans*, the only triggerplant named by Drummond, has not been considered in previous treatments of the genus (Bentham 1868; Mildbraed 1908); however, as noted by Barker & Barker (1990), there is sufficient diagnostic detail to qualify it as validly published under the Botanical Code. Drummond appears to be describing *S. plantagineum*, a magnificent species first published by Sonder (1845) that has relatively few, long, smooth, fibrous leaves and a tall scape with striking flowers. Like Drummond, Greg Keighery (*in sched.*) notes that populations from the Stirling Ranges (PERTH 1031716) failed to flower for numerous successive years. In contrast, I observed a large number of mature flowering plants and seedlings in a post fire habitat in this area in 1998 (PERTH 05595916), although at the time I did not realise the significance of this observation. The ability of this species to resprout from a partially or completely buried stem stock following a fire is evident on some herbarium collections (e.g. PERTH 06639755, PERTH 03172562), in which the leaf bases of the previous season's growth are scorched. Many perennial triggerplants appear to be disturbance-adapted, occurring in high numbers following temporary habitat perturbations such as fire, including *S. coroniforme* F.L.Erickson & J.H.Willis (Coates 1992) and *S. ferricola* Wege & Keighery (Wege *et al.* 2007). Whilst *S. plantagineum* responds well to fire, it doesn't necessarily require fire to stimulate flowering.

The following Drummond collections of *S. plantagineum* have been located: 2nd Collection No. 263 (MEL 2156144, MEL 21561445); 3rd Collection No. 79 (K 000060253, K 000355009); 5th Collection No. 350 (CGE, G, FI, K 000060252, K 000060922, P, TCD, W); and *Drummond s.n.* (MEL 2156101; a non-flowering collection). Drummond's letter to Hooker was written on February 21st 1844, which implies the type of *S. elegans* was collected in late 1843. Specimens from his 3rd Collection are known to have been gathered between 1843 and 1844 from Toodyay to Albany, east to Cape Riche, and in the Bolgart district, and were dispatched to London in 1844 (Maslin & George 2004). Two specimens from his 3rd Collection have been located, both of which were sent to Hooker. K 000060253, which comprises two flowering individuals, has been chosen as the lectotype of *S. elegans* since it is the better quality specimen. Furthermore, on one of the individuals, the previous season's leaf bases appear to be scorched, supporting Drummond's fire response observations.

***Stylidium preissii*** (Sond.) F.Muell., *Fragm.* 3: 122 (1863). *Forsteropsis preissii* Sond., in Lehm., *Pl. Preiss.* 1(3): 393 (1845). *Candollea preissii* (Sond.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type*: In clivulo arenoso promintorii Cape-Riche [Western Australia], 22 November 1840, *L. Preiss* 438 (*lectotype, here designated*: MEL 709983!; *isolectotypes*: LD!, MEL 709982!, ?MEL 709985!, S! W!).

*Typification.* Lowrie & Kenneally (1997: 360) cited the holotype of *S. preissii* as being at MEL; however, there is also material at LD to which Sonder likely had access (Crisp 1983). MEL 709983 is selected as a suitable lectotype since it is from Sonder's personal herbarium, bears detailed diagnostic information in his hand, as well as leaf and flower sketches.

**Stylidium pritzelianum** Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 66 (1908). *Type citation*: ‘West-Australien: Distr. Stirling: Plantagenet, Denmark, auf hümosem Conglomerat im Walde, beschattet (im Verblühen Mitte Januar 1901 – *L. Diels* n. 2267!)’ (*holotype*: B n.v., destroyed in WWII). *Neotype*: 600 m from Kordabup Road along track into Nature Reserve, track is 3.3 km north of South Coast Highway, north-west of Denmark, Western Australia, 21 November 2007, *J.A. Wege & C. Wilkins* JAW 1498 (*here designated*: PERTH 07854927; *isoneotypes*: CANB, MEL).

*Typification*. The holotype of *S. pritzelianum* was destroyed in WWII (Botanical Museum Berlin-Dahlem 1999) and I have not located any duplicate material. No other collections of this species from Diels and Pritzel’s expedition are known. The neotype conforms to the original description and is from the same vicinity as the original collection.

**Stylidium pseudocaespitosum** Mildbr., *Pflanzenr.* (Engler) IV. 278 (Heft 35): 56 (1908). *Type*: ‘Südlich der Mündung des Greenough River, östlich von Bukara auf sandigen Hügeln, 50 m ü. M. [Western Australia], September 1901, *L. Diels* 4231’ (*holotype*: B, n.v., destroyed in WWII). *Neotype*: South of Dongara on Eneabba Road, Western Australia, 7 September 1969, *A.M. Ashby* 3013 (*here designated*: PERTH 01875752!; *isoneotypes*: AD!, MEL 2259096!, RSA!).

*Typification*. Neotypification is necessary since the original material is no longer extant (Botanical Museum Berlin-Dahlem 1999) and duplicate material has not been located. No other collections of this species from Diels and Pritzel’s expedition are known. The neotype corresponds with the original description of the species, was collected close to the original locality and is supplemented by duplicate material.

**Stylidium scandens** R.Br., *Prodr. Fl. Nov. Holland.*: 570 (1810). *Candollea scandens* (R.Br.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘(M.) v.v.’ *Lectotype*: banks of Oyster Harbour River, King George III’s Sound, [Western Australia], December 1801, *R. Brown* Bennett No. 2595 (*lectotype, here designated*: BM 000812595!; *isolectotypes*: BM 000812586!, CANB 00279064! DBN, E! K 000060294!, K 000060297!, MEL 2104983!, P 00313126!). *Paralectotype*: banks of the lakes towards Cape How [Lake Powell, Western Australia], December 23–24 1801, *R. Brown* Bennett No. 2595 (BM 000812585!, BM 000812594!, K 000355275!), = *S. nymphaeum* Wege.

*Stylidium scandens* var. [published as β] *humile* Sond., in Lehm., *Pl. Preiss.* 1(3): 381 (1845). *Type*: In subarenosis hieme inundatis districtus Hay [between Balgarup and Lake Matilda, Western Australia], 8 November 1840, *L. Preiss* 2296 (*lectotype, here designated*: MEL 293424!; *isolectotype*: LD! FI!, MEL 293426!, MEL 293425!, MEL 293423!, TCD!, W!).

*Typification*. Robert Brown collected *S. scandens* in December 1801 whilst the *Investigator* was anchored at King George Sound. He made two separate gatherings, the first from the ‘banks of Oyster Harbour River’ at King George Sound and the second from the ‘banks of the lakes towards Cape How’, now known as Lake Powell (Vallance *et al.* 2001: 101). These two collections represent two distinct species, both of which have a scandent habit in which plants cling to surrounding vegetation by means of curled leaf tips; however, they differ in flowering period, plant height and flower morphology. Brown’s King George Sound collection (Figure 1, BM 000812595), which is in late flower and early fruit, is referable to a spring to early summer flowering species that commonly grows to 1 m high and, in the Albany region, has a magenta corolla with two simple throat appendages at the base of the anterior lobes and a column c. 9–12 mm long (Figure 2A–D). Brown’s collection from Lake Powell (Figure 1, BM 000812594), which is in early flower, represents a late spring to early Autumn flowering



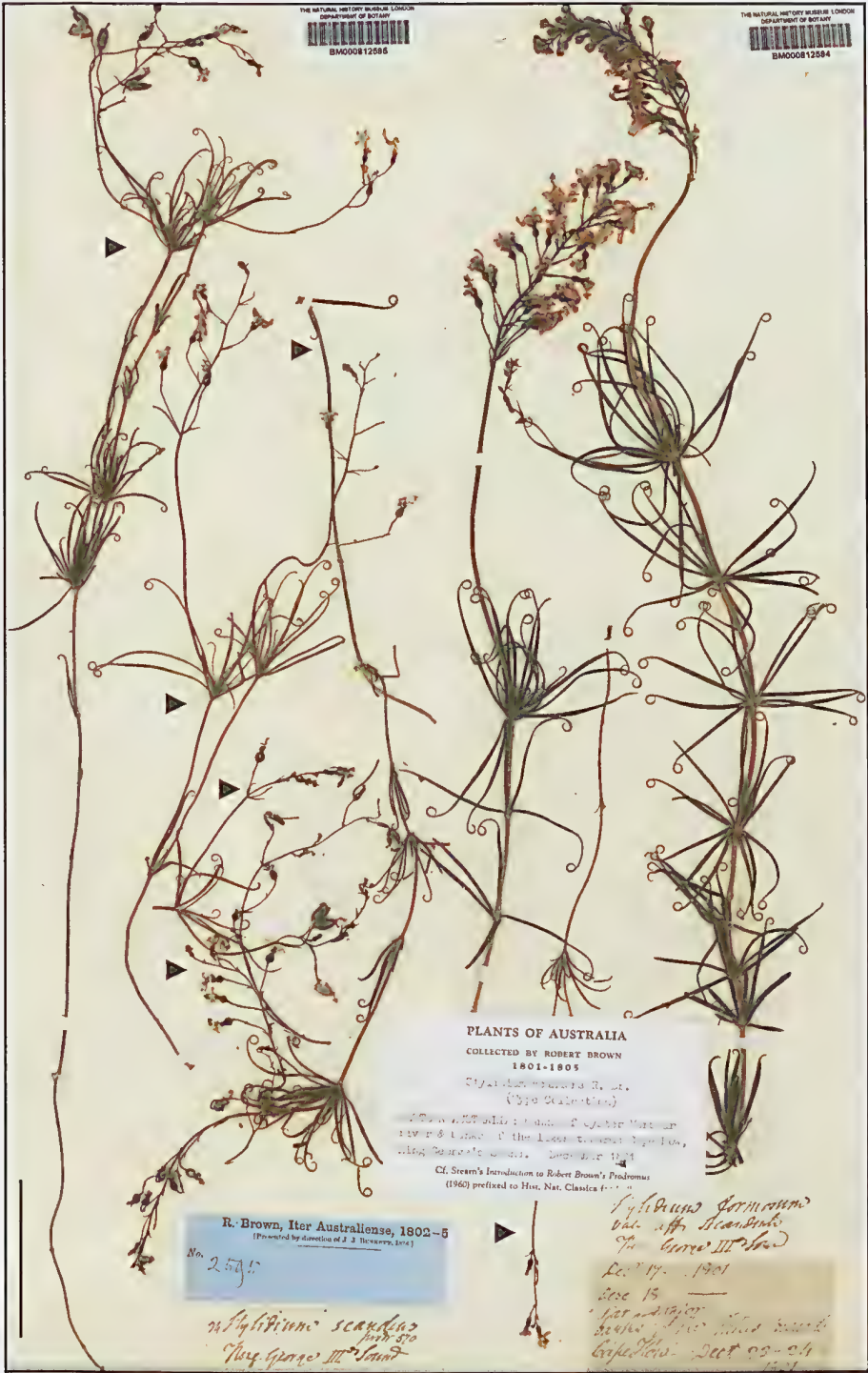


Figure 1. Robert Brown's type gatherings of *Stylidium scandens* housed at the Natural History Museum, London. The designated lectotype (BM 000812595) from King George's Sound consists of several plant portions, indicated with a black arrow. The paralectotype (BM 000812594) from the Lakes towards Cape How, is a discrete species named herein as *Stylidium nymphaeum*.



Figure 2. *Stylidium scandens*, typical form A – habit (J.A. Wege 844, W of Albany); B – inflorescence (J.A. Wege 1277, south of Stirling Ranges); C – flower (J.A. Wege 844); D – labellum (J.A. Wege 1035, West Mt Barren). *Stylidium nymphaeum* E – inflorescence (J.A. Wege 1181); F – flower, note the prominent throat appendages and crose corolla margin (J.A. Wege 1587); G – flower, note the very long lateral appendages on the labellum (visible behind the poised column).



species which can grow in excess of 2 m high and has a pale mauve corolla with erose margins, six or eight throat appendages, and a column 13.5–16 mm long (Figure 2E–G). It was this larger, more ornate species that was so beautifully illustrated by Ferdinand Bauer (Figure 3).

Examination of Brown's descriptive slips, housed in the Botany Library of the Natural History Museum London, has revealed that he considered naming the larger form as a distinct taxon. There is a separate descriptive slip for the larger form, which Brown gave the name *S. formosissimum*. The field slip on the corresponding herbarium collection is annotated as 'var. major' and a separate annotation slip is labelled '*Stylidium formosum* val[?] aff. *S. scandenti* King George III<sup>d</sup> Sound'. However, Brown was uncertain whether this larger form warranted separate taxonomic status, noting on one of his descriptive slips that Bauer's illustration 'is the larger *S. scandens* perhaps not specifically distinct from the common.' He ultimately included the larger form under his concept of *S. scandens* and therefore both gatherings must be considered type material. His type description is short and could be applied to either form. In keeping with his unpublished observations, I have selected material from the King George Sound gathering as a suitable lectotype of *S. scandens*, and have formally described the larger, more ornate form as *S. nymphaeum* (see new names below). The lectotype comprises several portions, which may or may not be from the same individual, but all are in agreement with one another and clearly part of the same gathering.

*Stylidium scandens* var. *humile* Sond. was named by Sonder (1845) but not recognised in subsequent taxonomic revisions (Bentham 1868; Mildbraed 1908). The type is referable to a low growing form of the species that I have placed under a broad concept of *S. scandens* (see notes below). The type locality (Hay District) is thought to be between Balgarup and Lake Matilda (Marchant 1990), although there are no present-day records from this area. The designated lectotype is from Sonder's herbarium and bears descriptive information in Sonder's hand and a packet containing a dissected flower used by him to compile his description.

*Notes.* *Stylidium scandens* varies in habit, corolla colour, labellum morphology, and throat appendage morphology (Figures 2A–D, 4). The typical form (e.g. *J.A. Wege* 814, 827, 844, 858, 1035, 1076, 1312, 1584) has a scandent habit, magenta corolla lobes with a white throat, two throat appendages (one on each anterior corolla lobe), and a labellum with long (2–3.5 mm) lateral appendages (Figures 2A–D, 4C). This form occurs from the western portion of Fitzgerald River National Park to the Denmark region, including the Stirling Range National Park.

A low growing form (Figures 4A, B) with a sprawling, bushy or semi-scandent habit exists in the Denmark and Mt Frankland regions and west thereof to near Margaret River (e.g. *J.A. Wege* 441, 442, 443, 534, 781, 804, 1264). This form is characterised by medium to pale pink, apricot-pink or yellow corolla lobes with red or pink throat markings, a pair of tooth-like throat appendages on each posterior corolla lobe and short (< 1.5 mm long) or no labellum lateral appendages (Figures 4D–F). The leaves of this low growing form are sometimes shorter than the typical form, and some of the leaves on a given individual may lack the characteristic curled tips of this species; however, leaf length and degree of apical curling are highly variable features, even within individuals. A newly discovered outlying population from near Bannister (*F. Obbens* 30/08) is noteworthy in consistently lacking curled leaf apices (like the allied sandplain endemic *S. nonscandens* Carlquist), although it has flowers that appear to fall within the range of variation seen in *S. scandens*.

In the Denmark region, the difference between the scandent and low growing habit forms can be marked and appears to be related to edaphic conditions, with the typical form occurring in gullies and winter-wet swamps and the low growing form in adjacent upland areas. However, the morphological





Figure 3. Ferdinand Bauer's illustration of *Stylidium nymphaeum*. Reproduced with permission from The Natural History Museum, London.

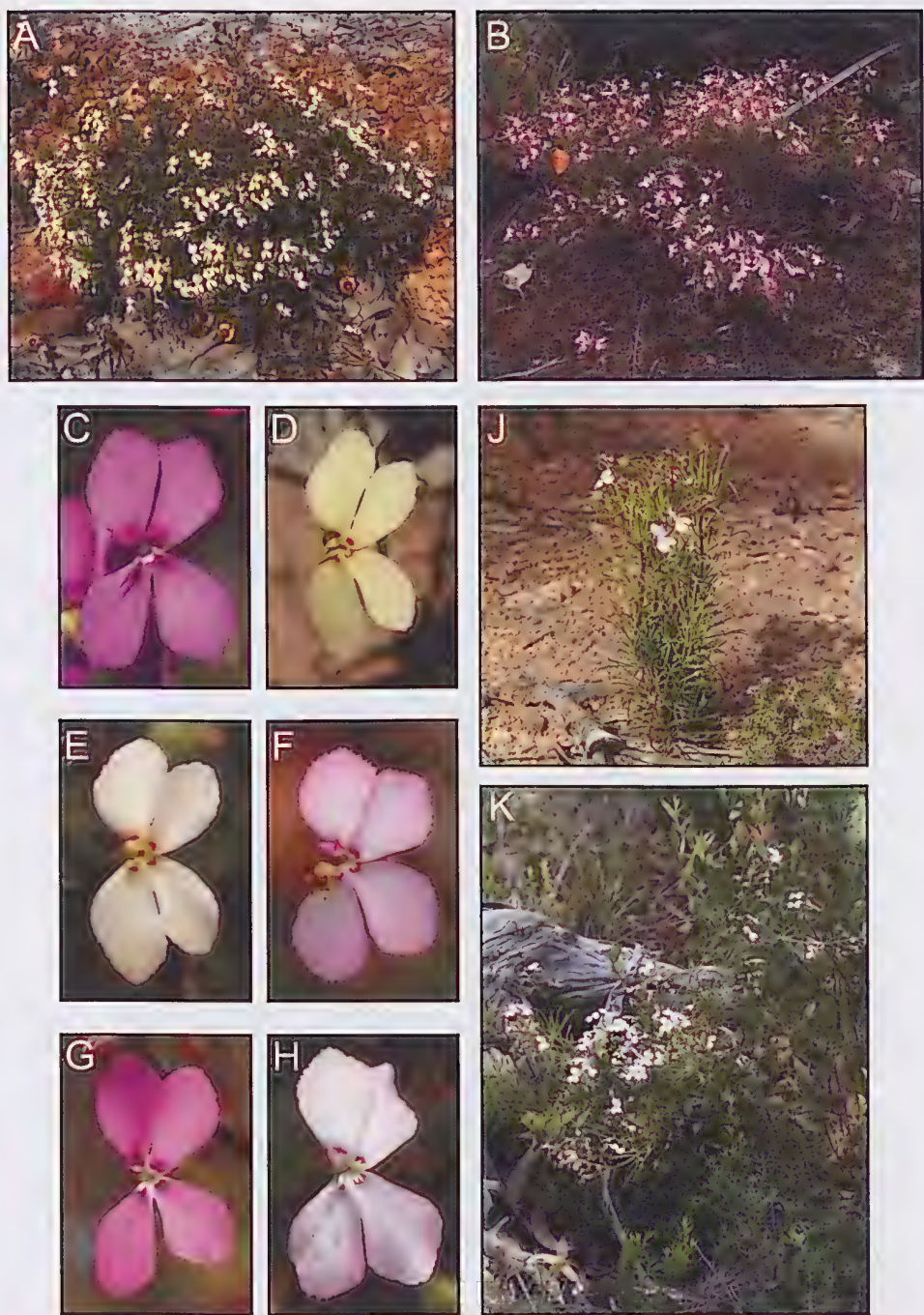


Figure 4. *Stylidium scandens* s. lat. A – low growing form (J.A. Wege 781, E of Margaret River); B – low growing form (J.A. Wege 803, S of Northcliffe); C – flower, typical form (J.A. Wege 844, W of Albany); D – flower, low growing form (J.A. Wege 781, E of Margaret River); E – flower, low growing form (J.A. Wege 1264, E of Margaret River); F – flower, low growing to semi-scandent form (J.A. Wege 1233, S of Busselton); G – flower, scandent form (J.A. Wege 1257, SE Busselton); H – flower, low growing to semi-scandent form (J.A. Wege 1266, SW Nannup); J – compact habit of an individual in a disturbed habitat (J.A. Wege 1482, NW of Nannup); K – a scandent individual from the same population as J in more intact vegetation.



variation present across the entire geographic range of *S. scandens* is complex and difficult to partition into meaningful taxa. The morphology of the throat appendages and the length of the labellum lateral appendages are not always correlated with habit form. For example, there are tall, scandent populations with throat and labellum appendages comparable to the low growing form (e.g. *J.A. Wege* 1257, SE of Busselton; Figure 4G), low growing populations without posterior throat appendages (e.g. *J.A. Wege* 815, N of Walpole) and scandent populations referable to the typical form of the species but possessing posterior throat appendages (e.g. *S. Barrett* 116, Stirling Range). Throat appendage variation within species of *Stylidium*, particularly the presence or absence of small teeth, is not uncommon. That they are variably present in some populations of *S. scandens* (e.g. *J.A. Wege* 825, N of Denmark; *J.A. Wege* 1582, NW of Denmark) suggests that they are not a taxonomically informative in this instance. Similarly, intrapopulation variation in flower colour and the presence and/or length of labellum appendages has also been observed. Moreover, habit can vary within a given population, with the height of mature plants constrained in part by the height of the surrounding vegetation. A more compact habit is prevalent in places where plants have little to no surrounding vegetation to cling to, such as disturbed roadsides and more open areas of vegetation (Figure 4J), but scandent or semi-scandent individuals can occur in the same populations in areas of more intact habitat (Figure 4K). In view of the complex variation exhibited by this species, a broad species concept is preferred at present. A more in-depth study utilising molecular techniques may provide taxonomic clarification.

***Stylidium stenosepalum*** E.Pritz., in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 590 (1905). *Type citation*: ‘Hab. in distr. Irwin pr. Mingenew in plagis apertis fruticosis flor. m.’, [Western Australia, September 1901], *L. Diels* 4225. (*holo*: B, *n.v.*, destroyed in WWII). *Neotype*: Junction of Bunney Road and Nebru Road, Wilson Nature Reserve, north-east of Eneabba, Western Australia, 22 September 2009, *J.A. Wege* & *K.A. Shepherd* JAW 1628 (*neotype*, here designated: PERTH 08134790; *isoneotypes*: CANB, MEL).

*Typification*. The type of *S. stenosepalum* was destroyed in WWII (Botanical Museum Berlin-Dahlem 1999) and duplicate material has not been located despite searches at a number of institutions. No other collections of this species from Diels and Pritzel’s expedition are known. The neotype conforms with the original description, and, like the holotype, is from the northern part of the range of this species. A revised description is provided in Wege (2006a).

***Stylidium thesioides*** DC., *Prodr.* 7(2): 783 (late December 1839). *Type*: ‘in Novâ-Hollandiâ ad Swan-river’, [Western Australia, 1835–1838], *J. Drummond s.n.* (*holotype*: G-DC!; *isotype*: BM 000797472!, BM 000797473!, CGE!).

*Stylidium canaliculatum* Lindl., *Sketch Veg. Swan R.* xxix (1 December 1839), *nom illeg. non* Poirlet (1817). *Candollea canaliculata* (Lindl.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882).

*Typification*. Lindley and De Candolle’s names are based upon the same Drummond gathering, acquired as part of his first unnumbered series (as for *S. ciliatum*; see typification notes above). Whilst Lindley was the first to publish a description for this taxon, his name is illegitimate since it had been previously used by Poirlet (1817).

***Stylidium verticillatum*** F.Muell., *Fragm.* 4: 94 (1864); *Candollea verticillata* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.*: 86 (1882). *Type citation*: ‘In montibus Stirling Range ad Mongerup’ [Mondurup Peak, Western Australia], *s. dat.*, *G. Maxwell s.n.* (*lectotype*, here designated: MEL 2156109!; *isolectotype*: MEL 293305!, ?K 000060299!)



*Typification.* The designated lectotype bears locality information in Maxwell's hand and Mueller's annotation '*Stylidium verticillatum*.'

MEL 293305 was also collected from 'Mongerup' and was annotated by Mueller as '*Stylidium aretioides*', presumably an unpublished manuscript name for this species. Whilst the collector is not indicated, the matching locality lends support to my interpretation of this sheet as a Maxwell duplicate. It is unlikely that a collection by James Drummond would bear such a precise locality, although he is known to have collected this species (n. 93, S.W. Australia, K000355195). *Stylidium verticillatum* is endemic to the Stirling Ranges and Mueller did not visit this area until October 1867 (Churchill *et al.* 1978), several years after he named this species. The fact that this specimen bears an unpublished manuscript name therefore suggests that Mueller did not collect it.

K000060299, a specimen from Oldfield's personal herbarium collected by Maxwell from the Stirling Range, is treated here as a possible isolectotype. In the absence of a precise locality statement, it is unclear whether MEL 2156107, collected by Maxwell from 'S.W. Australia', is part of the type gathering.

***Stylidium yilgarnense*** E.Pritz., in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 591 (1905). *Type citation:* 'in distr. Coolgardie pr. Goolhi in fruticetis arenosis' [Western Australia], October 1901, *E. Pritzel* 873 (*lectotype, here designated:* PERTH 03171647!; *isolectotypes:* AD 98421092!, AD 98421093!, BM!, G!, K 000060902!, M!, NSW!, P!, S! W!).

*Typification.* The specimen of *E. Pritzel* 873 housed at B was destroyed in WWII (Botanical Museum Berlin-Dahlem 1999); however, some of this material was acquired by Charles Gardner for the PERTH collection during his term as Australian Botanical Liaison Officer (Green 1990). I therefore consider the PERTH duplicate to be the most suitable choice for the lectotype of this species.

### New names

***Stylidium acuminatum*** (Carlquist) Wege, *comb. et stat. nov.*

*Stylidium spathulatum* R.Br. subsp. *acuminatum* Carlquist, *Aliso* 7(1): 38 (1969). *Type:* Between Collie and Harvey, Western Australia, 18 October 1967, *S. Carlquist* 3849 (*holo:* RSA!).

*Perennial herb* 5–45 cm high. *Glandular trichomes* 0.15–0.8 mm long, stalks translucent, heads yellow, turbinoid or discoid; *eglandular trichomes* 0.2–0.8 mm long, multicellular. *Stems* shortly elongated below the leaf rosettes, straw-coloured, ± branching at nodes; internodes leafy, 0.5–8 cm long, with glandular and/or eglandular hairs; stilt roots present. *Leaves* in tufted rosettes, ± persisting into the next growth season, narrowly oblanceolate to oblanceolate or spatulate, flat in T.S., 0.5–3.5 cm long, 1–8.5 mm wide; apex subacute, acute or acuminate, terminating in a callus; margin entire; faintly to conspicuously striate, with dense glandular and eglandular hairs on both surfaces. *Scapes* (1)2–16 per plant, 4–42 cm high, 0.3–1.7 mm wide, often bearing a few scattered sterile bracts, glabrous or with a sparse to dense indumentum of glandular and eglandular hairs throughout, or with hairs restricted to the lower portion; sterile bracts narrowly oblanceolate to subulate, 1.5–11 mm long, glabrous or with glandular and/or eglandular hairs. *Inflorescence* a botryoid or raceme, (2)5–65-flowered; bracts subulate, apex acute, margin entire, 1.2–6.5 mm long, glabrous, glandular, or with glandular and eglandular hairs; bracteoles similar but smaller; pedicels 4–20 mm long, with

glandular hairs, rarely with eglandular hairs. *Hypanthium* turbinoid to clavoid, 1.2–3.5 mm long, 0.6–1.3 mm wide, with faint longitudinal ridges, glabrous, glandular at base or densely glandular. *Calyx lobes* free, apex acute to subacute, margin entire, the 2 lower lobes slightly larger than the upper 3, 1.2–4 mm long, 0.4–0.9 mm wide, glabrous, glandular, or with glandular and eglandular hairs. *Corolla* pale yellow, darker yellow at throat but without discrete throat markings, glabrous; tube 0.5–0.8 mm long; lobes paired laterally, anterior pair longer and slightly broader than the posterior pair; anterior lobes elliptic to oblong, strongly arcuate on anterior margin, 3–6.2 mm long, 2.5–3.7 mm wide; posterior lobes elliptic, 2.8–4.5 mm long, 1.7–2.7 mm wide. *Labellum* reflexed and angled across the calyx, yellow; boss ovate to narrowly ovate, margin entire, 0.5–1 mm long, 0.3–0.6 mm wide, glabrous; terminal appendage 0.4–1 mm long; lateral appendages absent or to 0.6 mm long. *Throat appendages* yellow, irregularly toothed with acute tips, 0.1–0.7 mm long, interspersed with larger swollen mounds, glabrous. *Column* 4.5–6.5 mm long, glabrous; anther locules parallel to column axis, subtending hairs absent; stigma sessile, entire. *Capsules* ellipsoid or clavoid, c. 2–4 mm long excluding calyx lobes. *Seed* brown, 0.3–0.5 mm long, 0.2–0.3 mm wide, longitudinally ridged. (Figure 5)

*Diagnostic features.* Rosetted perennial with narrowly oblanceolate to spatulate leaves bearing a dense covering of both glandular and eglandular hairs; corolla lobes paired laterally, yellow, without red throat markings, and bearing glabrous throat appendages with acute tips; column quite short (4.5–6.5 mm long).

*Notes.* I have previously highlighted my intention to raise *S. spathulatum* subsp. *acuminatum* to species level (Wege 2006b). Unlike *S. spathulatum*, which has a glandular indumentum, *S. acuminatum* possesses both glandular and eglandular hairs, a combination that is uncommon within the genus. Its flowers tend to be smaller than those of *S. spathulatum* and the column is shorter (4.5–6.5 mm as opposed to 7.5–12 mm in *S. spathulatum*). Distinct throat markings are absent in *S. acuminatum*, and the throat of the flower bears conspicuous, irregularly toothed appendages with acute tips. In contrast, the flowers of *S. spathulatum* possess red throat markings and inconspicuous, blunt appendages. The two species share a very similar geographical distribution, ranging from near Albany north to the Collie area although *S. spathulatum* tends to prefer moister habitats. I have not observed the two species growing together, although Carlquist made a mixed gathering of these two species at a site east of Albany (*S. Carlquist* 3979, RSA), suggesting that they can occur in either sympatry or parapatry, at least in this region of the State.

*Stylidium acuminatum* has close morphological affinity to *S. rupestre* Sond., a species that can be readily differentiated by its more or less stoloniferous habit, completely glandular leaf indumentum, red or maroon throat markings, glandular hairs on the tips of the throat appendages, and longer column (8–12 mm). The geographic distributions of these two species are not known to overlap, with *S. rupestre* having a more easterly occurrence across the south coast of the State; however, their ranges almost abut near South Stirling, north-east of Albany.

*Stylidium acuminatum* exhibits geographically correlated variation in its indumentum. The typical form, which is only known from west of Collie, has a very dense indumentum on all plant parts except the corolla. Glandular hairs outnumber the eglandular hairs, so much so that they were apparently undetected by Carlquist (1969). The eglandular hairs are readily observed on the leaves under magnification, but are quite sparse on the scapes, occasional or absent on the bracts and calyx lobes, and apparently absent on the pedicels and hypanthium. In contrast, plants which occur from Margaret River to the Albany region tend to have a higher proportion of eglandular hairs, particularly on the leaves, and notably fewer hairs on the floral parts. The scapes are often glabrous, and when hairs are present they are usually restricted to below the inflorescence or the very base. The hypanthium

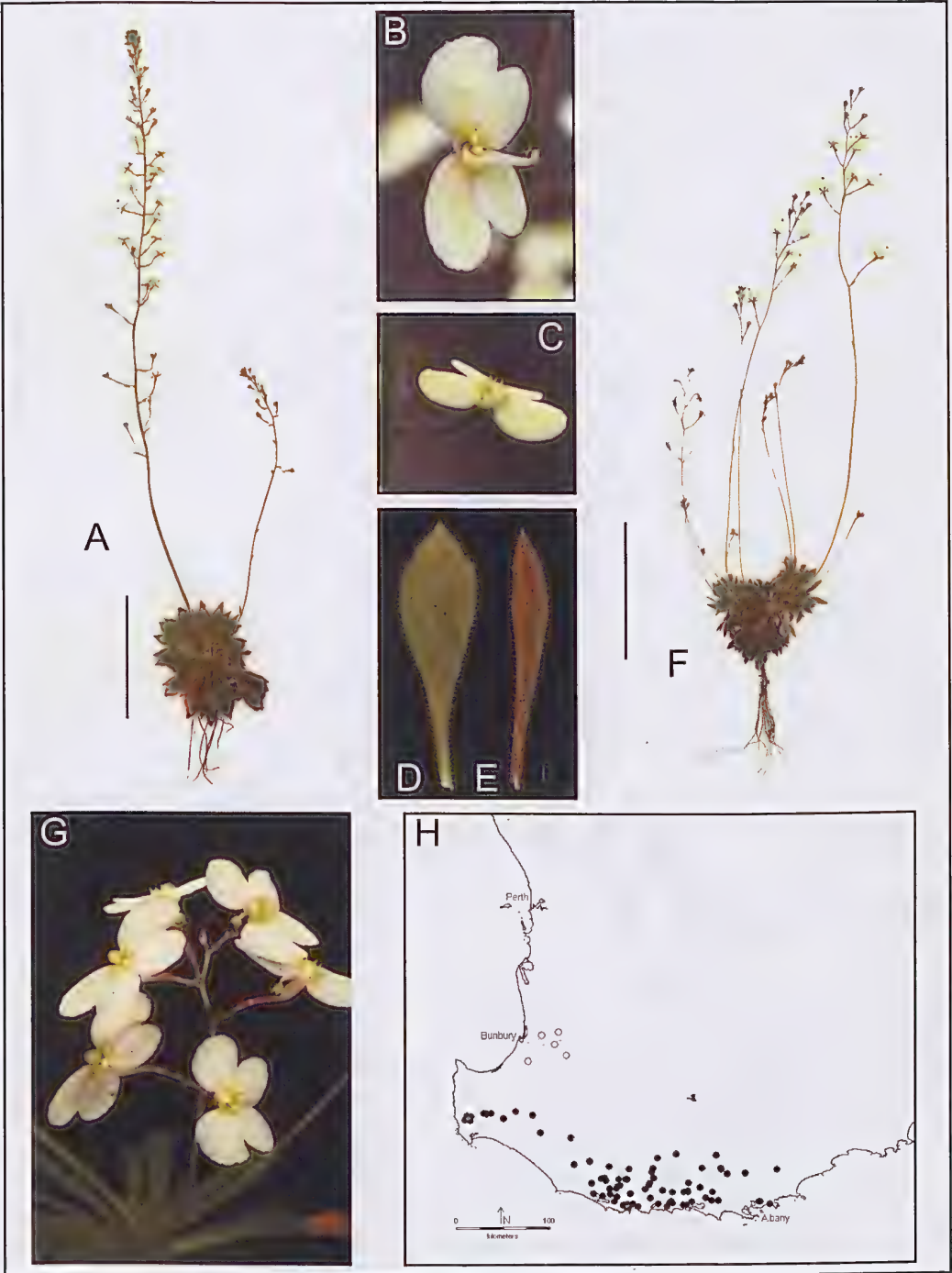


Figure 5. *Stylidium acuminatum* subsp. *acuminatum* (J.A. Wege 1250). A – habit; B – flower, with trigger released; C – side view of flower showing acute throat appendages and densely hairy scape, hypanthium and calyx; D – leaf. *Stylidium acuminatum* subsp. *meridionalis*. E – leaf; F – habit (J.A. Wege 811); G – inflorescence, with glandular hairs restricted to the pedicels (K.R. Thiele 3462); H – distribution of *S. acuminatum* subsp. *acuminatum* (o) and *S. acuminatum* subsp. *meridionalis* (●) in south-west Western Australia. Scale bars at 5 cm (A & F) and 1 mm (D & E).



and calyx lobes are usually glabrous, although glandular hairs may be present near the base of the hypanthium, and the calyx may have very sparse glandular and/or eglandular hairs. Since features of floral morphology are otherwise comparable throughout the geographic range of *S. acuminatum*, the southern, less hairy form is recognised herein at the subspecific level.

***Stylidium acuminatum* (Carlquist) Wege subsp. *acuminatum***

Leaves with a dense indumentum of both glandular and eglandular hairs. Scapes with dense glandular hairs throughout and sparse eglandular hairs mostly below the inflorescence. Bracts, bracteoles and calyx lobes with dense glandular hairs, often with sparse eglandular hairs. Pedicels and hypanthium with dense glandular hair, eglandular hairs absent. (Figure 5A–D)

*Specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation purposes] 2 Nov. 2005, *E.M. Bennett s.n.* (PERTH); 27 Nov. 1965, *A.R. Fairall* 1723 (RSA); 2 Feb. 1982, *J.M.Koch* 117 (PERTH); 1 Nov. 1991, *A. Lowrie* 451 (PERTH); 1 Nov. 2004, *J.A. Wege* 1250 (CANB, PERTH, MEL).

*Phenology.* Flowering in late October and November

*Distribution and habitat.* Known only from the central Jarrah Forest region west of Collie (Figure 5H) where it grows in lateritic soils on hillslopes and in valleys, in *Eucalyptus marginata* and/or *Corymbia calophylla* forest.

*Conservation status.* Recently listed as Priority One under DEC Conservation Codes for Western Australian Flora. A poorly known, apparently geographically restricted taxon that requires further survey. A record from the 1960s from near Wellington Dam suggests that this species may occur within Wellington National Park; however, field validation is required to ascertain whether this is the case.

*Notes.* This taxon was first collected in the 19th century by Ferdinand von Mueller from ‘Prestons and Collies River’ (MEL 2259092, MEL 2259093), by Alexander Morrison from Boyanup (E) and by Miss Bunbury (no locality: E).

***Stylidium acuminatum* subsp. *meridionalis* Wege, subsp. nov.**

*Stylidium acuminatum* subsp. *acuminatum* valde similis sed inflorescentiis indumentarum sparsis differt.

*Type:* 5 km east on Weld Road from Roe / Buckle Road junction, north-west of Mount Frankland, Western Australia, 11 November 2002, *J.A. Wege* 811 (*holotype*: PERTH 07940165; *isotypes*: CANB, MEL).

*Stylidium rupestre* auct. non Sond.: Wheeler *et al.* (2002: 910), *pro parte*.

*Stylidium rupestre* Sond. var. *abbreviatum* auct. non Mildbr: Erickson (1958: 111).

*Stylidium* sp. Mt Barker (E.J. Croxford 1906), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 6 January 2010]; Wheeler *et al.* (2002: 921).

Leaves with a dense indumentum of eglandular hairs and moderately sparse to very sparse glandular hairs, rarely with glandular hairs absent. Scapes glabrous throughout or with sparse to moderate eglandular and glandular hairs, mostly below the inflorescence. Bracts, bracteoles and calyx lobes glabrous, or with sparse eglandular and/or glandular hairs. Pedicels with glandular hairs, rarely with eglandular hairs. Hypanthium commonly glabrous, occasionally with sparse glandular hairs at base. (Figure 5E–G)

*Selected specimens.* WESTERN AUSTRALIA: near the E end of Porongurup on Chester Pass Road, 15 Oct. 1974, *S. Carlquist* 6033 (RSA); Rocky Gully, 18 Oct. 1951, *R. Erickson s.n.* (PERTH); at crossroads of Two Peoples Bay and Nanarup Roads, Oct. 1972, *S. James* 72 10/46 (PERTH); 20 km NNE of Denmark on Denmark - Mount Barker road, 20 Dec. 1993, *K.F. Kenneally* 11421 (PERTH); Shannon River c. 2 km upstream from the Broke Inlet, 26 Dec. 2007, *K.R. Thiele* 3462 (PERTH); Forest Grove National Park, 12 Nov. 2002, *A. Webb* AW 2219 (PERTH); c. 2.3 km E on Denny Road from Great North Road, ESE of Margaret River, 9 Nov. 2002, *J.A. Wege* 782 (PERTH, MEL); c. 1.2 km ESE on Quartz Road from Coronation Road, E of Manjimup, 10 Nov. 2002, *J.A. Wege* 793 (CANB, MEL, PERTH); c. 4.2 km N on Kordabup Road from South Coast Highway, Kordabup Nature Reserve, 21 Nov. 2007, *J.A. Wege & C. Wilkins* JAW 1496 (CANB, MEL, PERTH).

*Phenology.* Mostly flowering from mid October to December, with one record from late September and one from January.

*Distribution and habitat.* Occurs in the Warren and southern Jarrah Forest regions, extending into the western portion of the Fitzgerald subregion, from just south of Margaret River to north-east of Albany (Figure 5H). Grows in sand over laterite or sandy clay loams on ridges, hillslopes, lowlands, sometimes in association with granite outcropping or adjacent to creeklines. Commonly recorded from *Eucalyptus marginata* and *Corymbia calophylla* forest, often with a dense *Taxandria* understorey. Other associated vegetation includes *E. marginata* and *E. diversicolor* forest over a midstorey dominated by *Acacia* spp. and *E. staeri* forest with *Banksia coccinea*.

*Conservation status.* A common and widespread taxon. No conservation code applies.

*Etymology.* The species epithet means ‘southern’ in Latin and reflects this taxon’s distribution relative to the typical form of the species.

*Notes.* *Stylidium acuminatum* subsp. *meridionalis* is a relatively common taxon, represented by more than 90 collections at PERTH that were housed under 12 different names prior to this taxonomic assessment. It is much more widely distributed than indicated by Wheeler *et al.* (2002) who recorded it as having a restricted distribution in the Mt Barker and Walpole areas, under the name *S. sp.* Mt Barker (E.J. Croxford 1906). This was, in part, due to the incorrect referral of specimens of this taxon to *S. rupestre*. *Stylidium acuminatum* subsp. *meridionalis* has also been commonly confused with *S. spathulatum*, including by Carlquist, who referred a collection from the Porongurups area (*S. Carlquist* 6033) to this species. Both Bentham (1868) and Mildbraed (1908) viewed material of this taxon collected by Drummond (Ser. 3 No. 177: BM, CGE, E, K 000060696, P, TCD, W), treating it under *S. spathulatum*. This taxon was also historically collected by Oldfield from the Mt Barker area (K 003355097). Refer to the notes under *S. acuminatum* for a comparison with both *S. spathulatum* and *S. rupestre*.

***Stylidium angustifolium* (Carlquist) Wege, *comb. et stat. nov.***

*Stylidium glaucum* subsp. *angustifolium* Carlquist, *Aliso* 7(1): 40 (1969). Type: 6 miles south of Northcliffe, Western Australia, 16 October 1967, *S. Carlquist* 3799 (*holo*: RSA!).

Perennial herb 8–75 cm high. Glandular trichomes to 0.15 mm long, stalks translucent or yellowish, heads blackish, disciform; eglandular trichomes absent. Stems compact or shortly elongated between nodes, reddish-brown, leafless or leafy, ± branching at nodes; internodes to 4 cm long, glabrous; stilt roots present. Leaves in erect rosettes, ± scattered beneath, ± persisting into the following growth season, linear to narrowly oblanceolate, flat in T.S., 0.5–8 cm long, 0.7–3(–4) mm wide; apex acute, terminating in an inconspicuous, blunt callus; margin entire or minutely papillose; discolorous, glabrous. Scapes 1–7 per leaf rosette, 4–75 cm high, 0.2–2.2 mm wide, often bearing a few scattered sterile bracts, glabrous; sterile bracts linear to narrowly oblanceolate, 2–14 mm long, glabrous. Inflorescence racemiforme, (1–)3–65-flowered, glaucous; bracts linear-subulate to narrowly oblanceolate, apex subacute to acute, margin entire, 1.5–14 mm long, glabrous; bracteoles similar but smaller; pedicels 4–20 mm long, glabrous or with sparse glandular hairs at distal end. Hypanthium ellipsoid to ovoid, 1.5–2.8 mm long, 0.8–1.7 mm wide, faintly longitudinally ridged, glandular-hairy, sometimes sparsely so. Calyx lobes free, apex acute to subacute, margin entire, subequal, 1.8–3.5 mm long, 0.5–0.9 mm wide, glabrous. Corolla yellow with maroon throat markings, stained maroon on reverse, glabrous; tube 0.7–1.2 mm long; lobes paired laterally, anterior pair *c.* equal to or a little longer than the posterior pair; anterior lobes elliptic to narrowly ovate, slightly arcuate on anterior side, 3.7–5.5 mm long, 2–3.3 mm wide; posterior lobes elliptic to narrowly ovate, 3.5–5.5 mm long, 1.7–3.2 mm wide. Labellum reflexed and angled across the calyx, yellowish-maroon; boss ovate to elliptic, margin entire, 0.5–0.9 mm long, 0.4–0.7 mm wide, glabrous; terminal appendage 0.3–1 mm long; lateral appendages absent. Throat appendages 8, tooth-like with truncate to somewhat capitate tips, fused at base, grouped into 2 groups of 3 each 0.5–0.9 mm high, with the anterior-most appendages smaller, 0.1–0.3 mm high. Column 7–11 mm long; anther locules parallel to column axis, subtending hairs absent; stigma sessile, entire. Capsules ellipsoid, 2–3.5 mm long excluding calyx lobes. Seed brown, ellipsoid to oblong, 0.4–0.5 mm long, 0.2–0.25 mm wide, surface rugulose. (Figure 6).

*Diagnostic features.* A stilted, perennial habit; leaves arranged in tufted rosettes, linear to narrowly oblanceolate, flat in transverse section, glabrous and discolorous (paler on lower surface); unbranched and glaucous inflorescences; yellow corolla lobes with maroon throat markings and a prominent maroon stain on the reverse; 8 yellow or cream and glabrous throat appendages.

*Notes.* *Stylidium glaucum* subsp. *angustifolium* Carlquist and *S. luteum* subsp. *glaucifolium* Carlquist are morphologically more similar to one another than they are to the species they were originally named under. Carlquist's (1969) descriptions of these two taxa are very brief and lack information on the corolla parts. It is therefore unclear whether he closely examined their flowers, which are more or less comparable. I have combined these two taxa into a single species, recognising two subspecies (*S. angustifolium* subsp. *angustifolium* and *S. angustifolium* subsp. *glaucifolium*) that correspond to Carlquist's original taxa. Since *S. glaucum* subsp. *angustifolium* and *S. luteum* subsp. *glaucifolium* were published at the same time, neither name has nomenclatural priority. I have chosen to elevate *S. glaucum* subsp. *angustifolium* to species level since this epithet best describes this newly defined species and because the use of the epithet *glaucifolium* may cause some confusion with the allied species *S. glaucum*. *Stylidium luteum* subsp. *glaucifolium* is retained at subspecific rank and transferred to *S. angustifolium*.



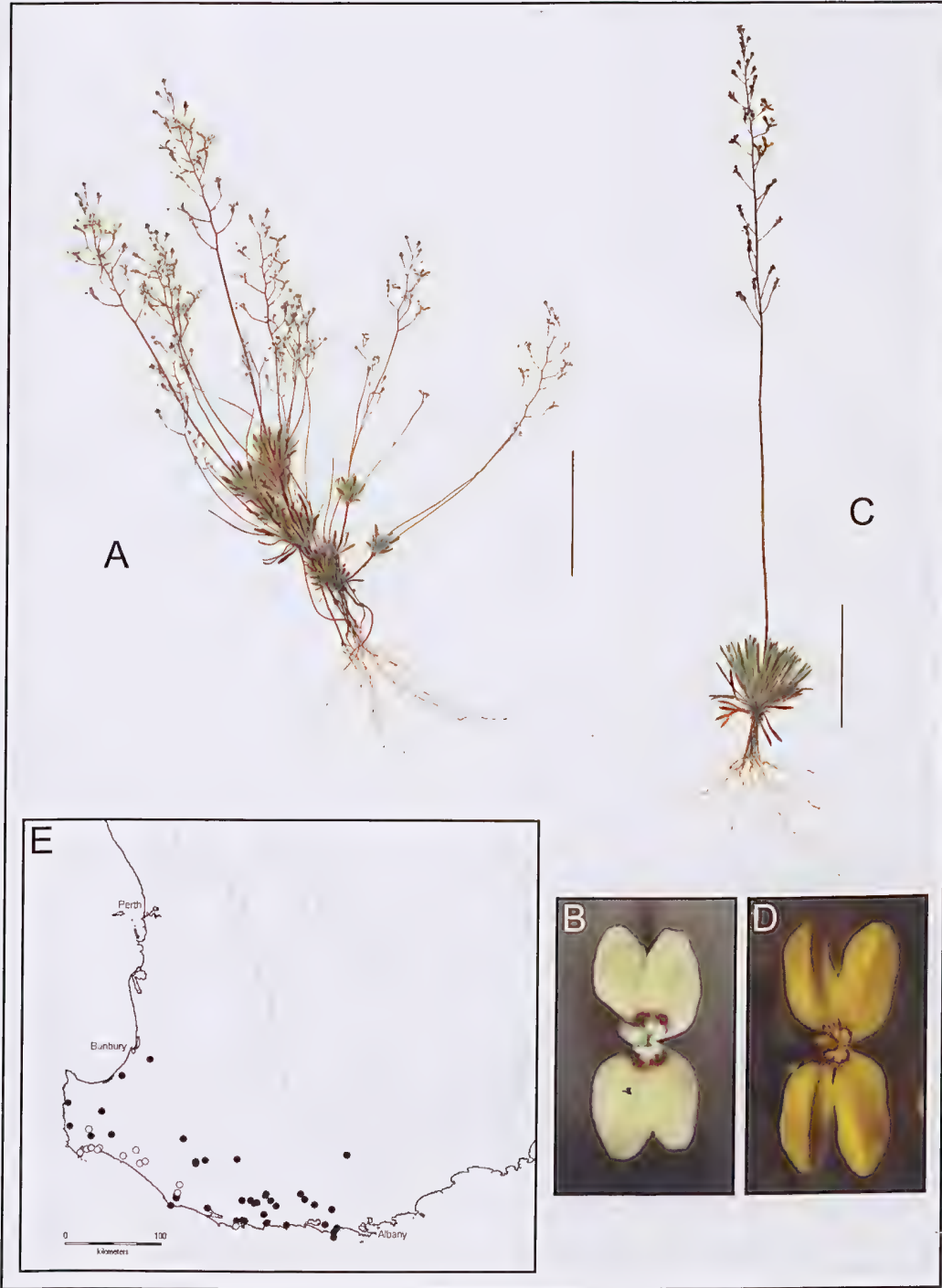


Figure 6. *Stylidium angustifolium* subsp. *angustifolium* A – habit (J.A. Wege 1574); B – flower (J.A. Wege 1569). *S. angustifolium* subsp. *glaucifolium* C – habit (J.A. Wege 1565); D – flower (J.A. Wege 1748). E – distribution of *S. angustifolium* subsp. *angustifolium* (○) and *S. angustifolium* subsp. *glaucifolium* (●) in south-west Western Australia. Scale bars at 5 cm.

*Stylidium angustifolium* differs from *S. glaucum* in both vegetative and floral features. It has a stilted habit in which the leaf rosettes are elevated above the soil on shortly elongated stems, whereas the stems and leaves remain at ground level in *S. glaucum*. The leaves of *S. angustifolium* tend to be narrower (0.7–3(–4) mm wide) than in *S. glaucum* ((2–)3–9 mm), and the corolla is yellow with prominent maroon markings rather than white or mauve. *Stylidium angustifolium* also has a longer column (7–11 mm long as opposed to 5.5–6.5 mm long in *S. glaucum*) and smooth rather than papillose seed. *Stylidium glaucum* has a morphologically distinct hypanthium in which small but distinct protuberances are positioned beneath the calyx lobes on the both the anterior and posterior sides (these are visible in pressed material). *Stylidium angustifolium* has an earlier flowering period than *S. glaucum*, extending from October to January with peak flowering in November and December (*S. glaucum* flowers from January to May, with peak flowering in late January and early February). Whilst these two species share a similar distribution and winter-wet habitat preference, they are not known to co-occur.

*Stylidium angustifolium* is more likely to be confused with *S. luteum*, a species which also has a stilted habit, narrow, glabrous leaves and yellow flowers. *Stylidium angustifolium* differs in a range of features including its discolorous leaves that are flat in transverse section (concolorous and subterete in *S. luteum*), unbranched (racemiform) inflorescences (usually branched (thyrsoid) in *S. luteum*), glaucous buds (buds lacking a white waxy coating in *S. luteum*), hypanthium with glandular hairs c. 0.1 mm long (hypanthium with more conspicuous glandular hairs c. 0.2 mm long in *S. luteum*), eight throat appendages (six in *S. luteum*), and glabrous seed (conspicuously papillose in *S. luteum*).

The two subspecies of *S. angustifolium* recognised below are defined on differences in habit and flower colour. *Stylidium angustifolium* subsp. *angustifolium* has a lax, branching and nodiferous habit in which short, leafless stems are produced between the rosette nodes (Figure 6A). The leaves are arranged in discrete rosettes at the nodes and are relatively short (0.5–3.5 cm long). Several delicate scapes are produced from each terminal rosette node that are normally less than 20 cm in height. The corolla lobes are pale yellow with maroon markings and cream throat appendages (Figure 6B). In contrast, *S. angustifolium* subsp. *glaucifolium* possesses a more upright, basally-rosetted habit in which the stems are usually more compact and often unbranched (Figure 6B). The stems can be shortly elongated below the leaf rosette and in some cases they branch; however, they tend to be leafy rather than bare. This subspecies also tends to have longer leaves and taller, more robust scapes with more flowers; however, these differences are not discrete. The corolla lobes and throat appendages are usually a bright, deep yellow in *S. angustifolium* subsp. *glaucifolium* (Figure 6E), rarely pale yellow (e.g. *J.A Wege* 1133). The flowers of the two subspecies are comparable in size, shape, throat appendage morphology and column morphology. I had originally intended to treat *S. angustifolium* subsp. *glaucifolium* as a distinct species; however, the similarity in floral morphology combined with the existence of specimens of *S. angustifolium* subsp. *glaucifolium* with more or less leafless stem internodes (e.g. PERTH04543858, PERTH07990286, PERTH04951514, PERTH03178331) suggests that a single species comprising two subspecies is more appropriate.

### ***Stylidium angustifolium* (Carlquist) Wege subsp. *angustifolium***

*Illustrations.* Carlquist (1969) p. 39, Figures 50 & 51, as *S. glaucum* subsp. *angustifolium*; Grieve & Blackall (1982) p. 730, No. 2a, as *S. glaucum* subsp. *angustifolium*.

*Perennial herb* 8–30 cm high. *Stems* internodes 1–4 cm long, leafless. *Leaves* 0.5–3.5 cm long, 0.7–1.5(–2.5) mm wide. *Scapes* (1)2–6 per leaf rosette, 4–22 cm high, 0.2–1 mm wide. *Inflorescence* (1–)3–20(–30)-flowered. *Corolla* pale creamy-yellow. *Throat appendages* creamy-white. (Figure 6A, B).

*Selected specimens.* WESTERNAUSTRALIA: Boggy Lake, 27 Dec. 1957, *D. Churchill* s.n. (PERTH); 5.1 km N on Black Point Road from Wapet Track, 30 Jan. 1997, *B. Evans & E. Bennett* P 11.14 (PERTH); Scott River plains E of Augusta, 8 Dec. 1974, *R. Pullen* 9900 (CANB, PERTH); Scott River plains, N of river, 30 Jan. 1965, *R.D. Royce* 8310 (PERTH); 800 m S on Della Rd from Warner Glen Mill Rd, SE of Margaret River, 9 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1569 (CANB, PERTH, MEL); 1.1 km W on Scott River Rd from Milyeannup Coast Rd, E of Augusta, 9 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1571 (AD, PERTH); 2.85 km from Vasse Highway on Scott Rd, D'entrecasteaux National Park, 9 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1574 (CANB, PERTH, MEL); 9.3 km S of Vasse Highway on Wheatley Coast Rd, S of Northcliffe, D'entrecasteaux National Park, 10 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1575 (PERTH, MEL).

*Phenology.* Mostly flowering from late November to January, extending into early February if seasonal conditions allow, with one record from mid October (*S. Carlquist* 3799).

*Distribution and habitat.* Largely restricted to the Warren region, between Walpole National Park and Scott National Park, extending into the southern Jarrah Forest region south-east of Margaret River (Figure 6E). Grows in sand or clayey sand in winter-wet swamps, usually amongst sedges. Associated vegetation includes dense *Taxandria* shrubland, low scrub dominated by *Homalospermum firmum*, and *Beaufortia sparsa* shrubland with emergent *Eucalyptus patens*.

*Conservation status.* Although *S. angustifolium* subsp. *angustifolium* has a reasonably restricted distribution it appears locally common at several sites within the conservation estate. No conservation listing is thought warranted.

*Notes.* Carlquist (1969: 40) describes the glandular trichomes as sessile; however, they are shortly stalked on the holotype and all other collections. Sessile glandular trichomes are not known to occur in the genus.

***Stylidium angustifolium* subsp. *glaucofolium* (Carlquist) Wege, *comb. nov.***

*Stylidium luteum* subsp. *glaucofolium* Carlquist, *Aliso* 7(1): 36 (1969). *Type:* 1 mile north of Manjimup, Western Australia, 10 November 1967, *S. Carlquist* 4061 (*holo:* RSA!; *iso:* K 000355313!).

*Stylidium glaucofolium* (Carlquist) Wege ms, Western Australian Herbarium, in FloraBase, <http://florabase.dec.wa.gov.au> [accessed 5 March 2010].

*Illustrations.* Carlquist (1969) p. 41, Figures 58–59, as *S. luteum* subsp. *glaucofolium*; Grieve & Blackall (1982) p. 733, No. 10a, as *S. luteum* subsp. *glaucofolium*.

*Perennial herb* (12–)25–75 cm high. *Stem* internodes to 1.5 cm, usually leafy. *Leaves* (1–)2–8 cm long, 1–4 mm wide. *Scapes* 1 or 2(–9) per leaf rosette, (10–)20–75 cm high, 0.6–2.2 mm wide. *Inflorescence* 12–65-flowered. *Corolla* bright, deep yellow, very rarely pale yellow. *Throat appendages* yellow. (Figure 6C, D).

*Selected specimens.* WESTERN AUSTRALIA: E side of Parry Rd, 3.4 km by road SE of South Coast Highway junction (Plot: pi5), 26 Nov. 1990, *N. Gibson & M. Lyons* 915 (PERTH); E side of South Western Highway, 2.25 km S of Deeside Coast Rd intersection (Plot: sw4), 19 Dec. 1990, *N. Gibson & M. Lyons* 1086 (PERTH); Romance Road, ca 1.5 km E of Collis Road, N of Walpole, 30 Dec. 2005, *M. Hislop* 3569 (PERTH); Shelley Beach Road, West Cape Howe, 25 km W of Albany,



7 Nov. 1986, *G.J. Keighery* 8548 (PERTH); Kodjinup Nature Reserve, 12 Dec. 1997, *G.J. Keighery* 15241 (PERTH); Amarillup Swamp NNE of Blue Lake, NNW of Denmark, 12 Dec. 1974, *R. Pullen* 9984 (CANB, MEL, PERTH); 3–5 km from Windy Harbour along road to Northcliffe, 17 Nov. 1982, *A. Strid* 21469 (M, PERTH, S); Forest Road, Crooked Brook Forest, SE of Dardanup, 14 Nov. 2003, *J.A. Wege* 1123 (MEL, PERTH); 700 m W on Cowaramup Bay Rd from Caves Rd, 14 Nov. 2003, *J.A. Wege* 1133 (PERTH); 1.54 km W on Ficifolia Rd from Peaceful Bay Rd, Walpole Nornalup National Park, 4 Dec. 2003, *J.A. Wege* 1169 (PERTH); 300 m S of Mount Chudalup turnoff, Northcliffe – Windy Harbour Rd, 5 Dec. 2003, *J.A. Wege* 1176 (CANB, PERTH); 1.2 km N of Centre Break Rd on Denmark – Mt Barker Rd, 21 Nov. 2007, *J.A. Wege & C. Wilkins* JAW 1500 (CANB, MEL, PERTH); 6 km west on Mowen Rd from Sues Rd, south of Busselton, 8 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1565 (AD, CANB, K, MEL, PERTH).

*Phenology.* Flowering specimens have been collected from mid October to early January.

*Distribution and habitat.* Scattered across the Warren and southern Jarrah Forest regions, from west of Torbay Inlet to near Gracetown, extending north to Crooked Brook Forest near Dardanup (Figure 6E). A collection by Ernst Pritzel (PERTH 03122387) from the Stirling Ranges appears referable to this species; however, there are no recent collections from this region at PERTH. Commonly found growing in sand, clayey sand, or sandy loam on winter-wet flats, at swamp margins and in gullies, more rarely on low rises. Associated vegetation is varied and includes *Taxandria* dominated shrubland, *Eucalyptus marginata* and *Corymbia calophylla* woodland with *Taxandria juniperina*, *Eucalyptus patens* woodland over *Taxandria* spp., open *Melaleuca preissiana* woodland over shrubland or heath, *Melaleuca* heath with tall sedges, *Beaufortia sparsa* scrub over sedges, and sedgeland.

*Conservation status.* Well represented in a number of conservation reserves. No conservation code is warranted.

*Chromosome number.* James (1979) recorded a count of  $n = 11$  from a population near Young's Siding (PERTH 03122530), under the name *S. luteum* subsp. *glaucofolium*.

### ***Stylidium nymphaeum* Wege, sp. nov.**

A Stylidio scandenti plantae elatiore, floribus ornatoribus, et columna longiore differt.

*Type:* 650 m north of South Western Highway on North Walpole Road, Walpole Nornalup National Park, Western Australia, 20 January 2003, *J.A. Wege & B.P. Miller* JAW 865 (*holo:* PERTH 07012381; *iso:* CANB, K, MEL, W).

*Illustrations.* Ferdinand Bauer, as *S. scandens* (Figure 3 herein); Ferdinand Bauer, field sketch reproduced in Pignatti *et al.* (2000) p. 103, Fig. 33a, as *S. laciniatum*; Mildbraed (1908), p. 52, Fig. 17A–D, as *S. scandens*.

*Scandent perennial herb* to 2.5 m high. *Glandular trichomes* 0.1–0.5 mm long, stalks translucent, heads reddish, ellipsoid to obloid, with somewhat truncate apices; eglandular trichomes present (tips of calyx), multicellular. *Stems* elongated, pale red-brown,  $\pm$  branching at nodes; internodes leafy, c. (10–)15–60 cm long (1.5–6 cm between each leaf whorl), glabrous; stilt roots forming from lower nodes, or absent. *Leaves* in whorls, rarely persisting into the next season, linear, abaxial midrib conspicuous, 1.5–7.5 cm long, 0.8–2 mm wide; apex acute, curled; margin entire or minutely papillose, revolute in dried material; glabrous. *Scapes* 1–5 per apical leaf rosette, 6–24 cm long,

(0.7–)1–2.5 mm wide, sterile bracts absent, glabrous. *Inflorescence* racemiform (botryoid), rarely thyrsoïd, (2–)4–60-flowered; bracts linear-lanceolate, apex acute and often recurved, margin entire, 5–23 mm long, glabrous or minutely papillose; bracteoles similar but smaller; pedicels 6–40 mm long, decreasing in length from base to apex, glabrous. *Hypanthium* subglobose to ellipsoid, 2.6–4.5 mm long, 1.8–3 mm wide, smooth, glabrous. *Calyx lobes* free but overlapping one another, apex obtuse and ciliolate, margin hyaline and irregularly crenate, 3 lobes slightly longer than the remaining 2, 2.6–4.5 mm long, 1.4–2.4 mm wide, surface glabrous. *Corolla* pale mauve to medium pink-mauve with a white throat, rarely all white; glandular on margins, on tube near anterior sinus and  $\pm$  on abaxial surface; tube 3–5 mm long; lobes paired laterally, each pair fused at base for *c.* 1 mm, the morphologically upper pair overlapping, the lower pair spreading, margin erose, anterior lobes similar in size to posterior pair; anterior lobes obovate, strongly arcuate on anterior side, 5.5–9 mm long, 3.8–7 mm wide; posterior lobes obovate, 5.5–8.5 mm long, 3.8–7 mm wide. *Labellum* reflexed, boss white to yellowish, ovate, 1.3–2.2 mm long, 0.9–1.2 mm wide; terminal appendage pink to white, 0.7–1.4 mm long, margin glandular; lateral appendages mostly pink, 3–6.7 mm long, with glandular hairs for most of length. *Throat appendages* 6 or 8, the same colour as the corolla, usually glabrous; appendages 1 or 2 at the base of each anterior lobe, the anterior-most appendage petaloid, obovate to elliptic, unequally tapering to an acute apex, margin erose or deeply incised, 1.8–5 mm long, 1.3–2.5 mm wide, occasionally with a few apical glandular hairs, the remaining appendage inconspicuous, lobed or tooth-like, to 1 mm high; appendages 2 at the base of each posterior lobe, each pair  $\pm$  fused at the base, subulate, 0.5–3.5 mm long. *Column* 13.5–16 mm long, with a distinct lateral curve, with glandular hairs from hinge to distal end; anther locules parallel relative to column axis, apiculate, subtending hairs present; stigma capitate, entire. *Capsules* globular, 4.5–7 mm long excluding calyx lobes. *Seeds* pale brown, oblong to elliptic, concavo-convex in T.S., 2–2.5 mm long, 0.8–1.5 mm wide, inconspicuously longitudinally striate, arillate. (Figures 2E–G, 3 & 7B)

*Selected specimens.* WESTERN AUSTRALIA: Nornalup, 21 Jan. 1936, *C.A. Gardner s.n.* (PERTH); Bow River, Dec. 1912, *S.W. Jackson s.n.* (CANB, K, MEL, PERTH); Lake William, West Cape Howe, 9 Jan. 1987, *G.J. Keighery* 9370 (PERTH); SW Plantagenet District, Jan. 1901, *E. Pritzel* 223 (BM, K, M, NSW, P, PERTH, S, W); Creek crossing Pingerup Road about 2 km from Chesapeake Road junction, D'Entrecasteaux National Park, 28 Mar. 2003, *C. Tauss* CT 3-10 (PERTH); 600 m S on Peaceful Bay Rd from South Coast Hwy 20 Jan. 2003, *J.A. Wege & B.P. Miller* JAW 866 (CANB, MEL, PERTH); 3.3 km on Broke Inlet Rd from South Western Hwy, D'Entrecasteaux National Park, 21 Jan. 2003, *J.A. Wege & B.P. Miller* JAW 870 (CANB, MEL, PERTH); 150 m S on Torbay Rd from Coombes Rd, W of Albany, 4 Dec. 2003, *J.A. Wege* 1159 (CAN, MEL, PERTH); Corner of Elleker - Grasmere Rd (E branch) and Lower Denmark Rd, W of Albany, 7 Jan. 2004, *J.A. Wege & B.P. Miller* JAW 1181 (PERTH); Spearwood Creek crossing on Denny Road, NE of Augusta, 28 Mar. 2005, *J.A. Wege & B.P. Miller* JAW 1332 (MEL, PERTH); *c.* 14 km N of South Coast Hwy on Mt Barker Rd, 12 Dec. 2008, *J.A. Wege & R. Butcher* JAW 1587 (PERTH); Walpole-Nornalup National Park, Isle Road, 15 Oct. 1991, *J.R. Wheeler* 2740 (PERTH).

*Phenology.* Flowering specimens have been collected from October through to July, with peak flowering from late December to March.

*Distribution and habitat.* Restricted to the Warren and southern Jarrah Forest regions, extending from near Albany to the Yelverton Forest, south of Dunsborough (Figure 7A). Grows in seasonally inundated swamps and flats, creeklines and waterlogged hill slopes. Recorded from a variety of habitats including dense *Taxandria* shrubland, open Jarrah and blackbutt woodland with *Astartea*, *Anigozanthos* and sedges, *Melaleuca preissiana* woodland with *Taxandria* and *Astartea*, Jarrah forest with a dense *Taxandria* understorey, Karri forest with *Acacia pentadenia*, and *Allocasuarina* woodland with *Agonis flexuosa*.





Figure 7. A – Distribution of *Stylidium nymphaeum* in south-west Western Australia; B – *Stylidium nymphaeum* at a site north of Denmark (J.A. Wege 1587), growing in sympatry with typical *S. scandens* (J.A. Wege 1588) visible below.

**Conservation status.** Locally common and well represented within the conservation estate. Not considered to be at risk.

**Diagnostic features.** A climbing habit which can reach more than 2 m high; elongated stems with leaves in discrete whorls; linear leaves with curled tips; pale mauve or medium pink-mauve corolla lobes with erose (irregularly toothed) margins; six or eight throat appendages, those nearest the labellum erose or deeply incised; a labellum with long lateral appendages (3.8–6.7 mm); a long (14–16 mm), glandular-hairy column; usually summer and autumn blooming.

**Etymology.** The species epithet is derived from the greek (*nymphae*, demi-goddesses who inhabit the sea, rivers, fountains, hill, woods or trees), in reference this species habitat preference.

**Notes.** *Stylidium nymphaeum* is a particularly striking species in view of its height and beautifully ornate flowers. The only other triggerplant that can grow to more than 2 m high is the equally spectacular *S. laciniatum* C.A. Gardner, a species that, in contrast to *S. nymphaeum*, possesses twining scapes and is often leafless when mature. Interestingly, these two species have a similar geographic distribution and both prefer winter-wet habitats; however, I have never observed them growing in sympatry.

*Stylidium nymphaeum* is morphologically allied to *S. scandens* but differs most obviously in having a taller habit (< 1.5 m high in *S. scandens*), larger anterior throat appendages (1.8–5 × 1.3–2.5 mm; 0.5–2.6 × 0.6–1.1 mm in *S. scandens*) with erose or incised margins (usually entire, rarely erose in *S. scandens*), longer posterior throat appendages (0.5–3.5 mm long; to 0.5 mm or absent in *S. scandens*), longer lateral appendages on the labellum (3.8–6.7 mm long; to 3.5 mm or absent in *S. scandens*), and a longer column (13.5–16 mm long; 9–12 mm in *S. scandens*). *Stylidium nymphaeum* also tends to have more prominently erose corolla lobe margins (entire, crenate tending erose in *S. scandens*), longer calyx lobes (2.6–4.5 mm long; 1.8–3 in *S. scandens*) and a longer corolla tube (3–5 mm long; 2–3.5 mm



in *S. scandens*), although these differences are not always discrete. Flower colour can be diagnostic, particularly the pale mauve populations of *S. nymphaeum* (Figure 2E–F), which are discernable from the magenta, pink, yellow and apricot flowers of *S. scandens* (e.g. Figures 2B–C, 4C–H), although some populations of *S. nymphaeum* have a richer colour approaching that in seen in some populations of *S. scandens*, and white flowers have been observed in both species. *Stylidium nymphaeum*, which blooms throughout summer and into Autumn, tends to have a later flowering time than *S. scandens* (October to December), although there is some overlap. The two species have been observed flowering together in December at a site north of Denmark (Figure 7B) without hybridisation.

Ferdinand Bauer's drawing of *S. nymphaeum* (Figure 3), which is housed at the Natural History Museum, London, is arguably the most exquisite of any *Stylidium* illustration. He probably based this illustration on his own collection, a duplicate of which has been examined at Kew (K 000060293). A duplicate is also known to exist at the Natural History Museum in Vienna (Bruno Wallnöfer, pers. comm.); however, this collection was housed separate to the main collection during my visits in 2003 and 2005 and could not be made available for study. Bauer's field sketch was incorrectly identified by Pignatti-Wikus *et al.* (2000: 83; Figure 33a) as *S. laciniatum* C.A. Gardner, and noted to be 'an exception as all species drawn by Bauer were usually described and named by Brown.' *Stylidium laciniatum* occurs from Denmark to the Blackwood River plateau, well west of the expedition's landfall. Refer to the typification notes under *S. scandens* for information regarding Robert Brown's collection of *S. nymphaeum*.

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## An account of *Eutaxia* (Leguminosae: Mirbelieae) with a focus on the Western Australian species

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### Abstract

Wilkins, C.F., Chappill, J.A. & Henderson, G.R. An account of *Eutaxia* (Leguminosae: Mirbelieae) with a focus on the Western Australian species. *Nuytsia* 20: 109–167 (2010). The Western Australian species of the endemic Australian legume genus *Eutaxia* R.Br. are revised. Twenty two species are recognised, all but three of them confined to Western Australia. Six new species are described, *E. acanthoclada* G.R.Hend. & Chappill, *E. inuncta* C.F.Wilkins & Chappill, *E. exilis* C.F.Wilkins & G.R.Hend., *E. hirsuta* C.F.Wilkins & Chappill, *E. lasiophylla* G.R.Hend. and *E. lutea* Chappill & G.R.Hend. *Pultenaea neurocalyx* Turcz. is transferred to *Eutaxia*, *P. neurocalyx* var. *major* Benth. is given specific status as *E. major* (Benth.) C.F.Wilkins & Chappill, and two new subspecies are recognised, *E. neurocalyx* subsp. *nacta* C.F.Wilkins and *E. neurocalyx* subsp. *papillosa* C.F.Wilkins. *Eutaxia diffusa* F.Muell. is reinstated as a distinct species rather than a variety of *E. microphylla*, and *E. empetrifolia* Schltdl. and *E. leptophylla* Turcz. are reinstated as distinct species rather than being synonymous with *E. microphylla* (R.Br.) C.H.Wright & Dewar. *Eutaxia densifolia* Turcz. and *E. dillwynioides* Meisn. are reduced to synonyms of *E. parvifolia* Benth. and *Eutaxia obovata* (Labill.) C.A.Gardner is placed in synonymy under *E. myrtifolia* (Sm.) R.Br. which now stands as the correct name for the type of *Eutaxia*.

### Introduction

*Eutaxia* R.Br. (Leguminosae: Mirbelieae) is a genus of 12 currently recognised species restricted to the south-west of Western Australia, except for *E. microphylla* (R.Br.) C.H.Wright & Dewar which occurs in South Australia, New South Wales, Victoria and Tasmania, *E. empetrifolia* Schltdl. which occurs in Western Australia and South Australia, and *E. diffusa* F.Muell. which occurs in South Australia, New South Wales, Victoria and southern Queensland. The genus was last revised by Bentham (1864), who recognised 8 species. His taxonomic framework has essentially remained unchanged with the exception of the substitution of the names *E. obovata* Turcz. for *E. myrtifolia* (Sm.) R.Br. (Grieve 1998), *E. microphylla* for *E. empetrifolia* (Wright & Dewar 1894, Grieve 1998), the division of *E. microphylla* into two varieties (var. *microphylla* (Court 1957) from the original *Sclerothamnus microphyllus* and var. *diffusa* from *E. diffusa*), and the publication of five new Western Australian species (Wilkins & Chappill 2007). Investigation of *Eutaxia* specimens housed at the Western Australian Herbarium



(PERTH) has uncovered a large number of misidentified specimens and a number of additional new taxa. This revision recognises 22 species in Western Australia, including six new species, two new subspecies, three reinstated species and two new combinations. *Pultenaea neurocalyx* Turcz. is transferred to *Eutaxia* (see notes below).

*Genus delimitation.* *Eutaxia* was first described by Robert Brown (1811) to accommodate specimens previously included within the genus *Dillwynia* Sm. Two species, *D. myrtifolia* Sm. and *D. obovata* Labill., were moved into the new genus under the name *E. myrtifolia* (Sm.) R.Br. Brown characterised *Eutaxia* as having a bilabiate calyx, swollen fruit, hooked style, capitate stigma and opposite leaves. All but the opposite leaves are shared with *Dillwynia*. At the same time, Brown described the new genus *Sclerothamnus* R.Br. based on *S. microphyllus* from the 'south coast of New Holland'. *Sclerothamnus* was distinguished from *Eutaxia* by its stipitate ovary, filiform style and simple rather than capitate stigma. It was subsequently reduced to a section within *Eutaxia* by Mueller (1858). Mueller's decision to unite *Eutaxia* and *Sclerothamnus* into a single genus may prove erroneous; however, until expanded phylogenetic analyses are undertaken to investigate the relationships between *Eutaxia*, *Dillwynia* and *Pultenaea*, the group of taxa with curved narrow style and simple stigmas are retained in this revision as *Eutaxia* sect. *Sclerothamnus*.

Crisp and Weston (1995) in a morphological cladistic analysis found that three-ribbed leaves and a ribbed calyx were synapomorphies for a clade comprising *Eutaxia*, *Sclerothamnus* and *Pultenaea neurocalyx*. A morphological study by Henderson (1998) supports the inclusion of *P. neurocalyx* within a monophyletic section *Eutaxia*, characterised by a broad style hooked just below the apex and a capitate stigma. The calyx ribs believed to be characteristic of both *Eutaxia* and *P. neurocalyx* were, however, observed to be no more prominent in many *Eutaxia* species than on some *Pultenaea* taxa. Molecular studies (Crisp *et al.* 1999, Orthia *et al.* 2005a, 2005b) also suggest that *P. neurocalyx* is more closely related to *Eutaxia* than to *Pultenaea* Sm. *s. str.*

Crisp and Weston (1995) also identified a single synapomorphy, opposite leaves, for *Eutaxia s. str.*; this feature has been generally used to distinguish the genus from *Dillwynia* and *Pultenaea*. This has resulted in some confusion in the past, however, with the more distantly related opposite-leaved species *Gastrolobium punctatum* (Turcz.) G.Chandler & Crisp and *G. reticulatum* (Meisn.) Benth. both being originally named in *Eutaxia*. Furthermore, opposite leaves are not present in *E. andocada* Chappill & C.F.Wilkins (alternate leaves), *E. actinophylla* Chappill & C.F.Wilkins (whorled leaves) or the six new taxa described herein with close affinity to *E. neurocalyx* (alternate leaves). Uncertainty therefore remains as to the true distinguishing features of the genus, as the characters previously used to define *Eutaxia* are not limited to the genus. Characters consistently present within the genus are adaxially concave leaves, absent or minute stipules and a calyx with three imbricate abaxial lobes and two valvate adaxial lobes in bud.

It should be noted that recent molecular phylogenetic analyses of the Mirbelieae genera (Chandler *et al.* 2001; Crisp & Cook 2003; Orthia *et al.* 2005b) have found that generic boundaries within the monophyletic NA (no antipodal cells) group (Cameron & Prakash 1994; Crisp & Cook 2003), to which *Eutaxia* belongs, are contentious. It has been proposed that all genera within the *Pultenaea s. lat.* group (including *Eutaxia*) be synonymised (Crisp & Cook 2003) under *Pultenaea* Sm. (Orthia *et al.* 2005b). If such reclassification proceeds it will not be in the near future and therefore the name *Eutaxia* is maintained here for this revision.

## Methods

The first author has examined, measured and recorded morphological information for all species of *Eutaxia* and completed the revision commenced by J. Chappill (deceased 2006) and G. Henderson (*Eutaxia* honours project 1998, whereabouts unknown). Herbarium specimens from A, AD, BM, BRI, CANB, G, GH, HO, K, MEL, NSW, P, PERTH, and fresh specimens from fieldwork collections, were examined by the second and third authors. The first author examined specimens from a subset of these herbaria (BM, G, K, MEL, P and PERTH) since specimens from the remaining herbaria were returned prior to completion of this revision. An exclamation mark! after the type specimen citation means viewed by the first author. The majority of *Eutaxia* species occur in Western Australia and are well represented at PERTH. While all species of *Eutaxia* have been examined, this paper has been restricted in scope to a revision of the genus in Western Australia, as re-examination of additional specimens from other Australian herbaria was not feasible. From specimens viewed by the first author, including the type specimens of *E. microphylla*, *E. empetrifolia* and *E. diffusa*, it is apparent that these three taxa are distinct species. Further new species may be present in eastern Australia.

Distribution maps were compiled using *Online map creation* freeware ([http://www.aquarius.geomar.de/omc\\_intro.html](http://www.aquarius.geomar.de/omc_intro.html)). Precise localities for threatened species have been withheld for conservation reasons.

## Taxonomic treatment

***Eutaxia*** R.Br., in Aiton, *Hortus Kewensis* ed. 2, 3: 16 (Oct.–Nov. 1811). *Type citation*: *Dillwynia myrtifolia* Sm., *D. obovata* Labill. *Lectotype* (here designated): *Eutaxia myrtifolia* (Sm.) R.Br.

*Sclerothamnus* R.Br., in Aiton, *Hortus Kewensis* ed. 2, 3: 16 (Oct.–Nov. 1811). *Type*: *Sclerothamnus microphyllus* R.Br.

Perennial *shrubs*, mat-like, prostrate, sprawling or typically erect, not resinous, not glandular, glabrous or with simple hairs. *Stems* unarmed or with pungent apices. *Stipules* absent or present, inconspicuous, free, interpetiolar, attached to the apex of the pulvinus. *Leaves* persistent, ascending, spreading or appressed, mainly opposite and decussate, alternate or in whorls of 3, simple, pulvinate, concave, margin entire, abaxial surface with one or three ribs, or ribs absent. *Flowers* mainly axillary, 1 or 2, often crowded at ends of branchlets; or with 2–7 flowers with bracts, that are clustered on a leafless, extended flowering section of stem, that is 2–12 mm long and towards the apex of the branchlet, with new leaf growth then extending on the stem above the flowering stem section. *Bracts* either one present in the axil of a vegetative leaf, or the flower subtended by a shorter and often broader and thinner-textured floral leaf, or the flower subtended by a vegetative leaf and bract absent. *Bracteoles* persistent on pedicels, lanceolate to broadly ovate. *Calyx* prominently or inconspicuously 6-, 10- or 25-ribbed, ecostate in bud, three abaxial (lower) lobes ovate, slightly or strongly imbricate and the apex acute; two adaxial (upper) lobes valvate and straight with the apex acute, or falcate (with one straight side and one curved side) with the apex truncate; adaxial lobes fused to a higher level than the three abaxial lobes; all lobes persistent on fruit. *Corolla* papilionoid, yellow throughout or yellow-orange to yellow with dark red markings, glabrous; *standard* lamina base cordate or truncate, with or without auricles; lamina broadly elliptic to broadly ovate, without callosities; the apex emarginate; *wings* oblong to slightly obovate, straight or downcurved; *keel* shorter than standard and wings, straight or slightly downcurved, oblong, slightly obovate or sub-triangular, the apex subacute to rounded. *Stamens* 10, free,

attached to hypanthium; *anthers* oblong, versatile, dorsifixed. Viscid threads observed in fresh pollen (*E. cuneata* J.Chappill 6475). *Intrastaminal disc* absent. *Gynoecium* sessile or stipitate, unilocular, partly or wholly covered in short hairs; *ovules* 2, funicles glabrous, 0.15–0.25 mm long; *style* either filiform, straight or bent, with a simple stigma, or thick and hooked just below a capitate stigma, style glabrous or sparsely hairy towards the ovary. *Fruit* round, ellipsoid, the placental margin straight and opposite margin curved, or both margins with the same curvature, straight, turgid or compressed; style remnant central or offset towards placental margin. *Seed* ellipsoid with slight or prominent radicular lobe, glabrous; aril white or cream, u-shaped around hilum. *Seed anatomy* with hour-glass cells present, tracheid bar present, malpighian cells present, linea lucida absent, mucilage layer present, counter-palisade present, cotyledon cells thin-walled (Chappill *et al.* unpublished data on *E. myrtifolia*). *Canavanine* present in *E. microphylla* (Bell *et al.* 1978). *Alkaloids* absent (Aplin & Cannon 1971). Not reported to be poisonous. *Root nodules* present (Lange 1959, 1961, Barnet 1988).

*Chromosome number.* 2*n* = 14, 16, 32 (Sands 1975).

*Typification notes.* Although *E. myrtifolia* was the first named species of *Eutaxia*, the name was at that time invalid since *Dillwynia obovata*, which is cited in synonymy, is an older name than *Dillwynia myrtifolia*. *Dillwynia obovata* is a well-known and widely cultivated taxon that has been widely known as *Eutaxia obovata* (Labill.) C.A.Gardner (Grieve 1998); however, this epithet had been previously used by Turczaninow (1853) to describe a different species (synonymous with *E. parvifolia*) before Brown’s error was noticed and the combination made from *D. obovata* by Gardner (1930). Although *E. myrtifolia* (Sm.) R.Br. was the incorrect name for the taxon at the time of publication, Turczaninow’s work has made the correct combination unavailable and *E. myrtifolia* has to stand as the correct name for the here designated lectotype of *Eutaxia* (see Article 52.3 of the ICBN; McNeill *et al.* 2006).

The name *Eutaxia* comes from the Greek *eu* (= well) and *taxis* (= arrangement), probably referring to the regular arrangement of the leaves.

Key to the species of *Eutaxia*

- 1. Calyx prominently 15–25-ribbed, spinescent branchlets absent.....2
- 1: Calyx with 12 or fewer inconspicuous ribs, or venation obscure;  
spinescent branchlets absent or present.....8
- 2. Keel apex yellow-orange (W.A.: from Peak Charles to W of Mt Ragged).....1.7. *E. lutea*
- 2: Keel apex red at least at apex .....3
- 3. Calyx outer surface and both leaf surfaces densely hairy or just calyx and upper  
leaf surface densely hairy (W.A.: Muntadgin to N of Hyden) .....1.4. *E. hirsuta*
- 3: Calyx outer surface glabrous (lobe margin with hairs); leaf surfaces glabrous,  
marginal hairs absent or present .....4
- 4. Calyx total length (from pedicel attachment to apex of lobe) 3.6–4.5(–5) mm long;  
majority of mature leaves < 2.5 mm long .....5
- 4: Calyx total length (4.5–)5–8.5 mm long; majority of mature leaves > 2.5 mm long.....7



5. Leaves erect but spreading; keel adaxial margin glabrous  
(W.A.: Harrismith to Forrestania and S to Chillinup Pool and South Stirling Ranges).....**1.10.a. *E. neurocalyx* subsp. *neurocalyx***
- 5: Leaves mainly appressed to stem; keel adaxial margin  
with minute hairs ..... **6**
6. Stem with dense, long hairs to 0.6 mm long  
(W.A.: E of Southern Cross to N of Bremer Range) ..... **1.10.b. *E. neurocalyx* subsp. *nacta***
- 6: Stem with dense, papillose hairs c. 0.05 mm long  
(W.A.: from NNW of Bullfinch to Newdegate) ..... **1.10.c. *E. neurocalyx* subsp. *papillosa***
7. Calyx outer surface dull, green-brown between ribs;  
leaf width 0.4–1 mm, leaf lower surface rib same width throughout  
(W.A.: Bremer Bay to Cape Arid) ..... **1.8. *E. major***
- 7: Calyx outer surface glossy, red-brown between ribs; leaf width  
1.3–2.5 mm, rib on lower surface of leaf widened toward apex  
(W.A.: Ravensthorpe and Cape Arid) ..... **1.5. *E. inuncta***
8. Style sturdy, hooked; stigma capitate ..... **9**
- 8: Style filiform, straight or curved, but never hooked; stigma simple ..... **15**
9. Adaxial two calyx lobes with truncate lip, free for < 0.6 mm ..... **10**
- 9: Adaxial two calyx lobes acute, free for > 0.7 mm ..... **11**
10. Leaves cuneate (wedge shaped) 2–12.5 mm long, apex obtuse  
or with short, blunted mucron (W.A.: Cheyne Beach to E of Munglinup) ..... **1.1. *E. cuneata***
- 10: Leaves obovate 4.5–21 mm long, apex acute to acuminate with long cream  
apiculus (W.A.: between Cape Naturaliste and Cape Arid) ..... **1.9. *E. myrtifolia***
11. Calyx inconspicuously 10–12-ribbed, bracteoles < 1 mm long;  
keel apex much narrower than base ..... **12**
- 11: Calyx inconspicuously 5–6-ribbed, bracteoles > 1.1(–4) mm long;  
keel apex almost same width as base ..... **13**
12. Leaves crowded, longer than internodes, 1.8–3.5 mm wide,  
apiculus rounded; standard lamina 5.8–6.7 mm wide  
(W.A.: N of Capel to Mt Many Peaks) ..... **1.2. *E. epacridoides***
- 12: Leaves distant, shorter than internodes, 0.4–1(–1.3) mm wide,  
apiculus acuminate; standard lamina 2.8–5.1 mm wide  
(W.A.: Harvey area to Whicher Range) ..... **1.3. *E. exilis***
13. Lower three calyx lobes < 2 mm wide; leaves glabrous ..... **14**
- 13: Lower three calyx lobes > 2 mm wide; leaves densely hairy at least  
on upper surface (W.A.: between Muntadgin, Bronti and Lake Cronin) ..... **1.6. *E. lasiophylla***
14. Habit slender with long branchlets; leaves usually distant,  
very narrowly obovate, oblanceolate to almost linear  
(W.A.: Perth to Augusta and E to Mt Many Peaks) ..... **1.12. *E. virgata***
- 14: Habit crowded with shorter branchlets; leaves usually crowded,  
obovate to elliptic, narrowly obovate (W.A.: widespread from Bolgart to  
Gracetown and E to Hatter Hill and Cape Arid) ..... **1.11. *E. parvifolia***

15. Keel yellow or yellow-orange throughout..... 16
- 15: Keel red at least at tip..... 18
16. Calyx outer surface with sparse, spreading, straight hairs *c.* 0.2 mm long  
(W.A.: Parker Range, Mt Holland, Forresteria, Lake Barker)..... 2.6. *E. lasiocalyx*
- 16: Calyx glabrous except for lobe margins..... 17
17. Erect shrub; tips of branchlets not spinescent; leaves in whorls of 3  
WA: Norseman, Salmon Gums, Mt Newmont)..... 2.2. *E. actinophylla*
- 17: Prostrate mat forming shrub; tips of branchlets spinescent; leaves alternate or  
irregularly arranged (W.A.: Forresteria to Mt Madden) ..... 2.1. *E. acanthoclada*
18. Leaves alternate, glabrous (W.A.: Peak Charles area) ..... 2.3. *E. andocada*
- 18: Leaves opposite and decussate, glabrous or hairy..... 19
19. Leaf and bracteole with apical apiculum uncinat; stems never spine-tipped  
(W.A.: from E of Mullewa to Lort River, W of Esperance)..... 2.7. *E. leptophylla*
- 19: Leaf and bracteole apex straight; stems with or without spinous tips..... 20
20. Leaves obovate or narrowly obovate, apex subacute or acute,  
leaves mainly > 5 mm long, not spinescent..... 21
- 20: Leaves ovate, narrowly ovate, oblong or narrowly elliptic, apex obtuse,  
leaves mainly < 4 mm long, apex branchlets often pungent ..... 22
21. Leaf narrowly obovate, apex subacute, base not distinctly tapered,  
not discolorous; fruit sub-globose 3–3.5 × 2.6–3 mm (south-west W.A., S.A.)..... 2.5. *E. empetrifolia*
- 21: Leaf distinctly obovate with apex acute, base narrowed to petiole,  
lower surface darker than upper surface; fruit ellipsoid, 5–6 × 3.3–4.5 mm  
(Qld, N.S.W., Vic., S.A., one collection ? W.A.)..... 2.4. *E. diffusa*
22. Calyx outer surface with sparse, white hairs; leaf abaxial surface verrucose,  
stems not pungent (W.A.: Beverley, Kokeby, Quairading, Yellowdine) ..... 2.10. *E. rubricarina*
- 22: Calyx glabrous except for lobe margins; leaf abaxial surface smooth except for rib ..... 23
23. Majority of mature leaves < 1 mm long (new growth leaves up to 3 mm long  
and narrowly ovate); leaf margin with hairs; apex of branchlets hairy,  
never pungent (W.A.: Riverina Station, S to Lake Cronin, Duranillin, Lake Magenta,  
Gnowangerup) ..... 2.9. *E. nanophylla*
- 23: Majority of mature leaves on plant > 1 mm long; leaves and stem glabrous,  
or rarely margins hairy; apical branchlets often pungent (N.S.W., S.A., Tas., Vic.)..... 2.8. *E. microphylla*

*Notes.* Two putative new species of *Eutaxia* have recently been collected and are recommended as priority species for further survey. They are from Jasper Hill (R.J. Cranfield 8607) and North Ironcap (P. Armstrong *et al.* 06/898). There is one fruiting specimen of each taxon and until further collection there is insufficient material for descriptions. Both have the following features: stipules minute; style filiform and bent, the stigma simple; calyx outer surface glabrous, without prominent ribs; fruit capsules prominently stipitate.

The first putative species from east of Jasper Hill superficially resembles *E. microphylla* with its pungent branchlets and small leaves but is easily identifiable in having narrowly obovate, verticillate leaves rather than being ovate and opposite - decussate. It differs from *E. actinophylla*, which also has verticillate leaves, in having distinctive, very long fruiting pedicels and glabrous fruits.

The second putative species is from north of North Ironcap. It is similar to *E. rubricarina* in having hairy, verrucose leaves and a red keel, but differs in having a glabrous calyx and alternate rather than opposite - decussate leaves.

**Eutaxia** R.Br. section **Eutaxia**, in F.Muell., *Fragm.* 1: 7 (Mar. 1858).

*Ovary* sessile or shortly stipitate (stipe < 0.6 mm); *style* thick and hooked just below the apex; *stigma* capitate.

**1.1. *Eutaxia cuneata*** Meisn., in Lehm., *Pl. Preiss.* 1: 65 (Sep. 1844). *Type citation*: 'In rupestribus collium Konkoberup hills (Kent) [Western Australia] d. 19. Nov. 1840. Herb. Preiss. No. 1022.' (*lecto*, here designated: LD; *isolecto*: G!, NY (image!)).

*Shrub*, erect, densely or rarely sparsely branched, 0.3–1.6 × 0.6–1.3 m. *Stems* grey-brown, to red-brown, not tuberculate, not spinescent, glabrous. *Stipules* mainly absent or cream, c. 0.15 × 0.1 mm. *Pulvinus* 0.2–0.5 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole* 0.4–0.8 mm long; *blade* discolorous, mid green over grey-brown, cuneate, 2–17 × 1.1–7 mm, abaxial surface smooth, with one prominent central vein and two faint lateral veins at base, both surfaces and margin glabrous, the apex obtuse or somewhat cuspidate, straight. *Flowers* axillary, in pairs or solitary. *Bracts* in the axil of a vegetative leaf, oblong or ovate, 0.7–1.2 × 0.4–0.8 mm. *Bracteoles* positioned c. halfway down pedicel, red-brown, ovate, 0.6–1.3 × 0.4–0.6 mm, both surfaces glabrous, margin and the apex with sparse, spreading, straight hairs c. 0.1 mm long. *Pedicels* straight, rarely recurved, 1.5–4 mm long. *Buds* excluding emergent petals 3.5–5 × 2.2–2.5 mm, glabrous except for margins of lobes. *Hypanthium* 0.4–0.55 mm long. *Calyx* inconspicuously 6-ribbed, green or red-brown without markings, or with red spots, dull; total calyx length 3.5–5 mm; three abaxial lobes fused at base for 1.5–1.9 mm, symmetrical, 1.5–2 × 0.8–1.3 mm; two adaxial lobes fused at base for 3.5–4.5 mm, broadly ovate, falcate, 0.3–0.5 × 1–1.3 mm, the apex truncate. *Standard* claw 2–3 × 0.35–0.8 mm; lamina base truncate, auriculate; lamina orange-yellow with a yellow, elliptic eye bordered by a brick red, broad halo; lamina elliptic to broadly ovate, 6.5–7 × 7.3–9.6 mm, emarginate indent 0.5–0.7 mm long. *Wings* claw 1.5–2.8 mm long; adaxial spur straight or slightly curved, 0.4–0.8 mm long; lamina orange-yellow, darker towards the base, straight or downturned, oblong to slightly obovate, 5.5–6.3 × 1.6–1.9 mm; the apex obtuse. *Keel* claw 1.5–2.3 mm long; lamina dark orange-red throughout, straight, more or less oblong, 4.2–4.7 × 1.7–1.8 mm, glabrous, the apex somewhat acute. *Stamen filaments* 2.1–5 × 0.1–0.3 mm; *anthers* yellow, 0.3–0.5 × 0.25–0.3 mm. *Gynoecium* sessile; *ovary* 2–2.8 × 0.6–0.8 mm, lower half glabrous, remainder with moderately dense, spreading, straight hairs, c. 0.6 mm long; *style* hooked towards the apex, 1.8–3.1 × 0.2 mm, lower 1/3 with moderately dense, spreading, straight hairs c. 0.6 mm long, glabrous on upper 2/3; *stigma* capitate. *Fruit* compressed, ellipsoid, placental margin straight, opposite margin curved, 5–5.2 × 2.6–2.7 mm, outer surface with scattered, appressed, straight and wavy hairs c. 0.2 mm long. *Seed* dark brown with black markings, ellipsoid, 2–2.4 × 1.4–1.45 mm; *aril* white, c. 1.5 × 0.5 mm. (Figure 1)

*Chromosome number*.  $2n = 16$  (voucher Sands 638.12.14; Sands 638.16.17 cited as *E. parvifolia* by Sands 1975).

*Selected specimens*. WESTERN AUSTRALIA: Fitzgerald River, 3 Aug. 1970, K.M. Allan 330 (MEL, NSW, PERTH); S of Jerramungup, 24 Aug. 1965, J.C. Anway 268 (PERTH); S of Ravensthorpe, Sep. 1925, W.E. Blackall & C.A. Gardner s.n. (PERTH); NW of Coujinup Hill, 12 Aug. 1983, M.A. Burgman 1992 (PERTH); W of Lort River Bridge, on S Coast Hwy, 18 Sep. 2000, J.A. Chappill, M.D.



*Crisp & L. Cook* 6475 (PERTH); Pallinup River Reserve, W of bridge, 16 Aug. 1986, *E.J. Croxford* 5059 B (PERTH); Montem [Mount] Desmond, 30 Aug. 1962, *C.A. Gardner* 14067 (PERTH); Kundip, 22 Aug. 1965, *C.A. Gardner* 16225 (PERTH); Junction of Fitzgerald and Lusetta Rivers, 12 July 1970, *A.S. George* 9967 (CANB, PERTH); Museum Greenbelt, Jerramungup, 15 Sep. 1994, *W.R. Lullfitz* 38 (PERTH); Fitzgerald R crossing on Hassell Hwy, 4 Nov. 1992, *T.D. Macfarlane* 2111 (CANB, PERTH); N end of Ravensthorpe Range SE of Mt Short, 30 Aug. 1980, *B.R. Maslin* 4768 (K, PERTH); SE of Ongerup, 12 July 1964, *K.R. Newbey* 3034 (MEL, PERTH); Location 900, in gully leading into Yerritup Creek, N of coast at Stokes Inlet, 25 Sep. 1968, *A.E. Orchard* 1184 (AD, CANB, PERTH); E of Jerramungup, 24 Aug. 1963, *V.E. Sands* 638.16.17 (PERTH, SYD); Needilup, Oct. 1986, *B. Smith* 28/86 (PERTH); W of Bremer Bay township, 1 Oct. 1966, *P.G. Wilson* 4333 (CANB, K, PERTH); S of road from Ravensthorpe to Hamersley R, 26 Aug. 1965, *E. Wittwer* 378 (PERTH).

**Distribution and habitat.** *Eutaxia cuneata* is found close to the south coast of Western Australia, from Cheyne Beach to Ravensthorpe (Figure 2). It has been collected in heath, scrub and open woodland on a range of soil types, including clay, loam, sand and gravel.

**Flowering period.** July to October.



Figure 1. Flowering stem of *Eutaxia cuneata*. Photo Mary Hancock.

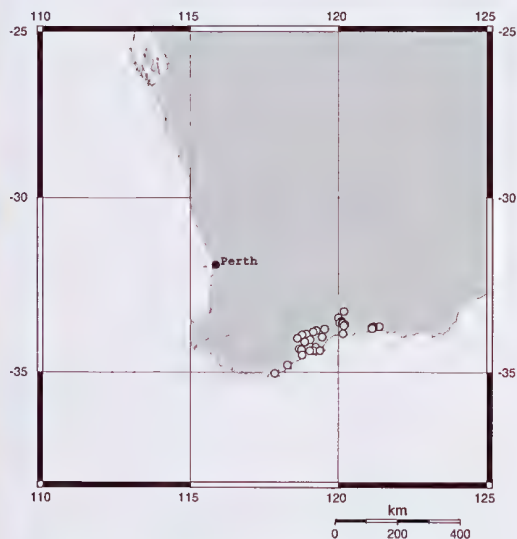


Figure 2. Distribution of *Eutaxia cuneata* in Western Australia.

*Conservation status.* This species is widespread and not considered to be under threat at this time.

*Etymology.* From the Latin *cuneatus* in reference to the cuneate leaf shape present in this species.

*Notes.* *Eutaxia cuneata* most closely resembles the commonly cultivated species *E. myrtifolia*. These species share the distinctive truncate adaxial calyx lip and small (c. 1 mm long) ovate bracteoles positioned towards the middle of the pedicel. They differ only by their leaf form, *E. cuneata* having cuneate leaves with an obtuse or apiculate apex while *E. myrtifolia* has obovate leaves with an acute to acuminate apex. The leaves of *E. cuneata* are also generally smaller (2–12.5 mm long), than those of *E. myrtifolia* (4.5–21 mm long).

The type specimen at LD has been chosen as the lectotype over the NY specimen as it is of superior quality (Crisp pers. comm. 2009). Both sheets were viewed by Meissner (see Crisp 1983).

**1.2. *Eutaxia epacridoides*** Meisn., in Lehm., *Pl. Preiss.* 1: 64 (Sep. 1844). *Type citation*: 'In solo turfoso inter frutices densos prope montes Melville et Elphinstone (Plantagenet) d. 11. Oct. 1840. Herb. Preiss. No. 412 et 867.' *Lecto, here designated*: *L. Preiss* 867 (LD); *isolecto*: G!, GOET, MO, NY (image!), P!, W. *Paralecto*: *L. Preiss* 412 (G!, MEL, NY (image!)), PERTH! 00861197, PERTH! 01006746, S).

*Shrub*, erect to spreading or decumbent, sparsely branched, 0.25–1.2 × 0.15–0.6 m. *Stems* green, smooth or tuberculate, not spinescent, glabrous. *Stipules* cream, 0.1–0.3 × 0.1–0.15 mm. *Pulvinus* 0.2–1 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole* 0.3–0.8 mm long; *blade* concolorous grey-green, or abaxial surface darker grey-green, narrowly elliptic, 9.5–20 × 1.8–3.8 mm, abaxial surface smooth, ribs absent or with one prominent central vein and two faint lateral veins at base, both surfaces and margin glabrous; the apex acute and straight. *Flowers* axillary, in pairs or rarely solitary. *Bracts* in the axil of a vegetative leaf, ovate, 1–1.8 × 0.6–1 mm. *Bracteoles* on middle to upper portion of pedicel, red-brown, subulate, 0.4–0.9 × 0.3–0.6 mm; both surfaces glabrous; margins with scattered, spreading, straight hairs c. 0.05 mm long. *Pedicels* recurved, rarely straight, 1.3–4.1 mm long. *Buds* excluding emergent petals 5.5–6.5 × 1.2–2.3 mm, glabrous except for margins of lobes. *Hypanthium* 0.3–0.7 mm long. *Calyx* prominently 10- or rarely 12-ribbed, green or red-brown without markings, dull; total calyx length 5.5–6.5 mm long; three abaxial lobes fused at base for 1.2–2 mm, equal in length or middle lobe slightly longer, 2.3–3 × 0.7–0.9 mm, with lateral lobes 1.9–2.9 × 0.65–0.9 mm; two adaxial lobes fused at base for 2.8–3.6 mm, ovate, straight or falcate, 0.8–1.5 × 0.8–1.2 mm, the apex acute. *Standard* claw 2.5–2.8 × 0.35–0.5 mm; lamina base truncate, with or without auricles; lamina yellow-orange with red markings on front surrounding a pale yellow eye, back almost completely dark red; lamina elliptic to obovate, 6–7.1 × 5.7–6.7 mm, emarginate indent 0.5–1.3 mm. *Wings* claw 2.3–2.6 mm long; lamina adaxial spur straight, c. 0.4 mm long; lamina yellow-orange infused with pale red at the base, straight, oblong to slightly obovate, 5.3–5.7 × 1.2–1.4 mm; the apex rounded to truncate. *Keel* claw 2.1–2.7 mm long; lamina deep maroon red at the apex fading to cream at the base, straight, triangular, 4–6.4 × 1.3–1.4 mm, glabrous; the apex narrow, subacute. *Stamen filaments* 2.2–5 × 0.15–0.3 mm; *anthers* cream, 0.25–0.4 × 0.2–0.25 mm. *Gynoeceium* sessile or with stipe to 0.25 mm long; *ovary* 1.3–1.8 × 0.4–0.7 mm, with moderately dense, spreading, straight hairs 0.6–0.8 mm long, evenly distributed or more dense towards the apex; *style* hooked towards the apex, 1.7–3.3 × 0.15–0.35 mm, glabrous; *stigma* capitate. *Fruit* compressed, ellipsoid, c. 5.5 × 2.7 mm, placental margin slightly curved, non-placental margin strongly curved, outer surface with scattered, spreading, straight hairs c. 1 mm long towards the apex. *Seed* brown, with or without black markings or black, ellipsoid, 2–2.1 × 1.2 mm; *aril* cream, c. 0.8 × 0.4 mm.

*Chromosome number.*  $2n = 16$  (voucher Sands 638.12.2; cited by Sands 1975).

*Selected specimens.* WESTERN AUSTRALIA: Karridale, Oct. 1905, *C. Andrews s.n.* (PERTH); Busselton - Nannup Road, Busselton, 21 Sep. 1975, *A. Annels* 1119 (PERTH); Kordabup Road, 12 Sep. 1991, *A.R. Annels* 1655 (PERTH); E of Bornholm, 17 Sep. 1966, *E.M. Bennett* 1138 (PERTH); Along South Western Hwy, NW of Walpole, 11 Sep. 1971, *R.Y. Berg* RYB 173 A (PERTH); Stewart Road, W of Vasse Highway, 30 Nov. 2000, *J.A. Chappill & C.F. Wilkins* 6579 (PERTH); Torbay, *s.dat.*, *A. Cayzer s.n.* (PERTH); NNE of Windy Harbour, 6 Sep. 1995, *R.J. Cranfield* 10332 (PERTH); Swan River, *s.dat.*, *J. Drummond* 2: 128 (K); Western foot of Mt Manypeaks, 5 Sep. 1935, *C.A. Gardner* 3332 (PERTH); W of Denmark, 10 Sep. 1957, *R.T. Lange* 240, (PERTH); W of St John Brook, 12 Sep. 1957, *R.T. Lange* 266 (CANB, PERTH); W of Darradup/Vasse Hwy intersection and N of Darradup Road, 21 Jan. 1997, *C. McChesney & P. Ellery* B 62.11 (PERTH); W of Nicol Road/Thompson Road intersection, N of Nicol, 12 Feb. 1997, *C. McChesney & C. Day* W 19.7 (PERTH); Rosa Brook, 9 Sep. 1976, *G.S. McCutcheon* 805 (PERTH); Scott R, E of Augusta, 21 Sep. 1973, *E.C. Nelson* ANU 17301 (CANB, PERTH); Cowaramup, 30 Oct. 1947, *R.D. Royce* 2449 (PERTH); Margaret R, 16 Oct. 1954, *R.D. Royce* 4899 (PERTH); Alexandra Bridge - Manjimup, 17 Aug. 1963, *V.E. Sands* 638.12.2 (PERTH, SYD); From Walpole towards Shannon, Darling District, 20 Sep. 1983, *J. Taylor & P. Ollerenshaw* JT 1996 (CANB, PERTH); W of Walpole, 8 Sep. 1965, *B.L. Turner* 5500 (PERTH).

*Distribution and habitat.* Endemic to Western Australia, *Eutaxia epacridoides* occurs in coastal regions in the south-western corner of Western Australia, from N of Capel to Mt Manypeaks (Figure 3). It is usually found in swampy lowland areas on sandy soil in open woodland or shrubland, and is often associated with *Eucalyptus marginata*.

*Flowering period.* August to November.

*Conservation status.* This species is widespread and not considered to be under threat at this time.

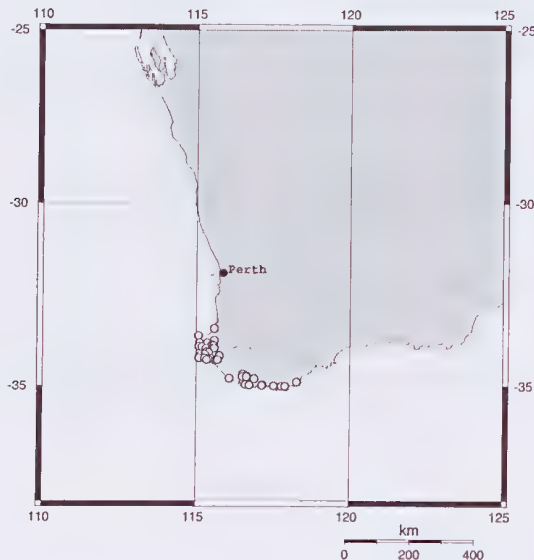


Figure 3. Distribution of *Eutaxia epacridoides* in Western Australia.



**Etymology.** The epithet *epacridoides* is in reference to the epacrid-like appearance of this species.

**Notes.** *Eutaxia epacridoides* and *E. exilis* can be easily distinguished from other *Eutaxia* species by their distinctive, prominently 10–12-ribbed calyx. This species differs from *E. exilis* by having larger flowers, leaves that are overlapping, dense and generally larger (4.5–18 mm long) and the apex while acute has a blunted apiculus rather than being acuminate.

The flowers are similar in shape to those of *E. virgata*, but that species has larger (2–3.7 mm long) bracteoles and only five calyx ribs. The very small (*c.* 1 mm long) subulate bracteoles of *E. epacridoides* and *E. exilis* are similar to those of *E. myrtifolia* and *E. cuneata*, but the first two species have adaxial calyx lobes with an acuminate apex, rather than having a truncate adaxial calyx lip that is characteristic of the latter two species.

The LD specimen of Preiss 867 has been chosen as the lectotype as suggested by M.D. Crisp (pers. comm. 2009). The labelling on the LD sheet is unambiguous. On the left of the sheet is a specimen that is the most complete (a whole plant including the root), with a full descriptive label including the Preiss number 867 and annotated '*Eutaxia epacridoides* nob.' by Meissner. The other specimen (on the right of the sheet) is also fully and clearly labelled, with the number 412. On the NY sheet the left hand specimen has a number 867 on a paper tag slipped over the stem, but the right hand specimen is unlabelled. This will, however, provide an unambiguously labelled islectotype of 867 in NY (and also a labelled packet).

### 1.3 *Eutaxia exilis* C.F. Wilkins & G.R. Henderson, *sp. nov.*

*E. epacridoides* affinis sed internodio longitudine folium superantes, floribus parvioribus et pedicellis brevioribus, apiculo folii acuminato non obtuso differt.

**Typus:** east of Blackwood and Great North Roads, Western Australia [precise locality withheld for conservation reasons], 21 October 1998, R. Davis 7689. (*holo:* PERTH 05139414!).

*Eutaxia epacridoides* subsp. *sparsifolia* G.R. Henderson ms, Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

**Shrub** erect to straggling or decumbent, sparsely branched 0.20–1 × 0.15–0.6 m. **Stems** red-brown or green, smooth or slightly tuberculate, not spinescent, glabrous. **Stipules** cream, 0.1–0.3 × 0.1 mm, rarely absent. **Pulvinus** 0.2–0.4 mm long. **Leaves** spreading, opposite and decussate, internode length longer than leaf length, **petiole** 0.1–0.3 mm long; blade concolorous mid-green, narrowly elliptic, 3–12 × 0.7–1.2 mm, not tuberculate, abaxial surface with one prominent central vein and two faint lateral veins at base, both surfaces and margin glabrous; the apex acuminate, straight. **Flowers** axillary, in pairs or rarely solitary. **Bracts** in the axil of a vegetative leaf, lanceolate, 1.4–2.3 × 0.4–0.6 mm. **Bracteoles** on mid to upper portion of pedicel, brown, subulate, 0.3–0.9 × 0.25–0.3 mm, both surfaces glabrous, margins with scattered, spreading, straight hairs *c.* 0.05 mm long. **Pedicels** recurved or straight, 0.6–1.3 mm long. **Buds** excluding emergent petals 3.8–4.8 × 1.2–2 mm, glabrous except for margin of calyx lobes. **Hypanthium** *c.* 0.3 mm long. **Calyx** prominently 10–12-ribbed, red-green or pale red-brown without markings, ribs paler red, slightly glossy or dull between ribs; total calyx length 3.8–4.8 mm; three abaxial lobes fused at base for 1.1–1.5 mm, middle lobe slightly longer, 2.2–3.3 × 0.8–0.9 mm, lateral lobes 1.9–2.8 × 0.65–0.9 mm; two adaxial lobes fused at base for 2.5–2.9 mm, ovate, straight or rarely falcate, 0.8–1.5 × 0.8–1 mm, the apex acute. **Standard** claw 2.2–2.7 × 0.5–0.6 mm; lamina base

truncate, without auricles; lamina yellow-orange with dark red markings surrounding yellow-green eye, lower surface predominantly dark red, elliptic to obovate,  $3.1\text{--}4.6 \times 2.8\text{--}5.1$  mm; emarginate indent 0.5 mm long. *Wings* claw 1.8–2.4 mm long; lamina adaxial spur straight, c. 0.4 mm long; lamina yellow-orange infused with pale pink at the base, straight, oblong,  $3.1\text{--}4.5 \times 0.7\text{--}1.2$  mm, the apex rounded to truncate. *Keel* claw 1.8–2 mm long; lamina orange-red at the apex fading to cream at the base, straight, narrowly triangular,  $4\text{--}4.8 \times 0.8\text{--}1.2$  mm, glabrous, the apex narrow and rounded. *Stamen filaments*  $2.2\text{--}3.7 \times 0.15\text{--}0.3$  mm; *anthers* cream,  $0.25\text{--}0.4 \times 0.2\text{--}0.25$  mm. *Gynoecium* sessile or with stipe to 0.25 mm; *ovary*  $1\text{--}1.1 \times 0.3\text{--}0.5$  mm, with moderately dense, spreading, straight hairs 0.6–0.8 mm long, evenly distributed or more dense towards the apex; *style* hooked towards the apex,  $1.5\text{--}2 \times 0.15\text{--}0.2$  mm, glabrous; *stigma* capitate. *Fruit* compressed, ellipsoid, placental margin slightly curved, non-placental margin strongly curved, immature size  $3.3 \times 1.5$  mm, outer surface with scattered hairs c. 0.7 mm long, mainly towards margins. *Seed* not seen. (Figure 4)

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] 23 Sep. 1992, *A. Annels* 2456 (PERTH); 29 Sep. 2000, *R.R. Archer* 92 (PERTH); 12 Dec. 1996, *N. Casson & P. Ellery* 82.2 (PERTH); 11 Dec. 1996, *N. Casson, P. Ellery & C. McChesney* SC 74.5 (PERTH); 3 Sep. 1997, *P.A. Jurjevich* 1120 (PERTH); 13 Oct. 1948, *R.D. Royce* 2797 (PERTH); 23 Oct. 1952, *R.D. Royce* 3915 (PERTH).

*Distribution and habitat.* *Eutaxia exilis* has been collected from scattered localities near Harvey, Nannup, Margaret River and near the Blackwood River (Figure 5). It is found in low lying, damp areas on sandy soils, with associated vegetation of very low open woodland, or shrubland.

*Flowering period.* September to November.

*Conservation status.* Recently listed as Priority Three under the Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora, due to its restricted habitat and distribution.

*Etymology.* From the Latin *exilis* (= thin) in reference to the sparse, narrow, leaves present in this species compared with its closest relative *E. epacridoides*.

*Notes.* Superficially this species resembles *E. virgata* due to the small, sparsely distributed leaves, and it has been mistaken for this species in the past. It can be distinguished by the prominently 10-ribbed calyx, very small bracteoles, long, narrow keel petals and acuminate leaf apices. *Eutaxia epacridoides* can be differentiated from *E. exilis* by its more densely distributed, generally broader leaves, larger flowers and the more blunted leaf apiculus.

Some specimens have been labelled *E. epacridoides* subsp. *Whicher Range* (R. Davis 7689) but this name is not recorded on *FloraBase*.

The epithet *sparsifolia* was unsuitable for use at species level as *E. sparsifolia* (= *Dillwynia uncinata* (Turcz.) J.Black) was previously described by Mueller in 1855.



Figure 4. Flowering stem of *Eutaxia exilis* (scan of section of holotype PERTH 05139414); scale bar = 1 cm.

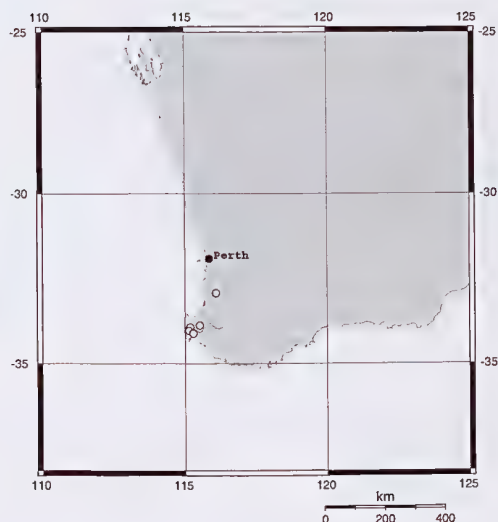


Figure 5. Distribution of *Eutaxia exilis* in Western Australia.

#### 1.4. *Eutaxia hirsuta* C.F.Wilkins & Chappill, *sp. nov.*

*Caulis et calyx dense pilosus. Species tomento denso in calyce et caulibus a congeneribus diversa.*

*Typus:* Wogarl Reserve, Western Australia [precise locality withheld for conservation reasons], 21 October 2000, *A. Gunness, B. Moyle, A. Bellman s.n.* (W.A. Wildflower Society) (*holo:* PERTH 05802644!; *iso:* CANB!).

*Eutaxia neurocalyx* (Turcz.) Chappill & G.R. Henderson subsp. *hirsuta* Chappill & G.R. Henderson ms, Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008]

*Shrub* erect, sparsely branched, *c.* 45 cm high, width unknown. *Stems* red-brown, smooth, not spinescent, with dense, spreading, straight hairs 0.4–0.7 mm long. *Stipules* absent. *Pulvinus* 0.4–1 mm long. *Leaves* closely appressed, alternate, internode length shorter than leaf length; *petiole* 0.1–0.15 mm long; blade concolorous grey-green, not tuberculate, ovate, 0.7–3 × 0.8–1.2 mm, abaxial surface 0–3 prominent ribs, margins and both surfaces with dense, spreading, straight hairs 0.5–0.8 mm long, the abaxial surface glabrescent; the apex obtuse and straight. *Flowers* mostly axillary; solitary or in pairs, and/or with 2–5 flowers with bracts clustered on a 1–2 mm long, leafless, densely hairy flowering stem section towards the apex of branchlets. *Bracts* similar to floral leaves but shorter, broader and thinner-textured, ovate, 2.5–3.5 × 1.8–3 mm. *Bracteoles* on upper portion of pedicel, brown, ovate, 3.5–4.3 × 1.2–1.8 mm, margin and both surfaces with dense, spreading, straight hairs *c.* 0.7 mm long. *Pedicels* straight, 0.6–4.1 mm long. *Buds* excluding emergent petals 4.5–5.5 × 2.5 mm, with



dense, spreading, straight hairs 0.8–1.7 mm long on outer surface and margin of lobes. *Hypanthium* 0.3–0.5 mm long. *Calyx* prominently 25-ribbed, red brown with cream ribs, dull; total calyx length 4.5–5.5 mm long; three abaxial lobes fused at base for 2–2.3 mm,  $3.2\text{--}4.3 \times 1\text{--}1.6$  mm; two adaxial lobes fused at base for 4.4–5 mm, ovate, straight or falcate,  $1.2\text{--}2.3 \times 0.7\text{--}1$  mm, acute. *Standard* claw  $2.5\text{--}4.5 \times 0.5\text{--}0.7$  mm; lamina base rounded, slightly auriculate; lamina yellow-orange with red markings around yellow eye, red-brown on back, obovate or elliptic,  $6.3\text{--}10 \times 7\text{--}9.3$  mm long; emarginate indent 0.3–0.6 mm. *Wings* claw 2.5–4 mm long; lamina adaxial spur straight or curved, *c.* 0.4 mm long; lamina yellow, downturned, obovate,  $5.5\text{--}7 \times 2.5\text{--}2.6$  mm, the apex rounded to truncate. *Keel* claw 2.6–3.5 mm long; lamina deep red at the apex fading to cream at the base, straight, oblong,  $3.9\text{--}4.5 \times 1.6\text{--}1.8$  mm, glabrous, the apex rounded. *Stamen filaments*  $3.3\text{--}6.7 \times 0.25\text{--}0.3$  mm; *anthers* cream,  $0.4\text{--}0.5 \times 0.3$  mm. *Gynoecium* sessile; *ovary*  $1\text{--}1.8 \times 0.4\text{--}0.7$  mm, with moderately dense, spreading, straight hairs 0.6–0.8 mm long, evenly distributed or denser towards the apex; *style* hooked towards the apex,  $3.8\text{--}4.4 \times 0.3\text{--}0.4$  mm, glabrous; *stigma* capitate. *Fruit* and *seed* not seen. (Figure 6)

*Chromosome number.* Unknown

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] *s.dat.*, *E.T. Bailey* 266 (PERTH); Sep. 1947, *E.T. Bailey* 301 (PERTH); 14 Oct. 1968, *J.S. Beard* 5762 (PERTH); Nov. 1971, *W.H. Butler s.n.* (PERTH).

*Distribution and habitat.* *Eutaxia hirsuta* is known only from Muntadgin to north of Hyden (Figure 7). It occurs on sandy, gravelly sand plains in low open heath.

*Flowering period.* September to November.

*Conservation status.* Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora.

*Etymology.* From the Latin *hirsutus* (= covered in coarse hairs) referring to the long, dense hairs present on the calyx.

*Notes.* *Eutaxia hirsuta* differs from the other species in the densely hairy calyx, stem, bracts and bracteoles. As well as the dense hair difference, *E. hirsuta* differs from *E. neurocalyx* in having the standard obovate rather than being ovate, with a longer claw (2.5–4 mm rather than being <2 mm long) and the calyx is longer (5.5–7 mm rather than being 4–5.5 mm long).

Specimens of this species at PERTH have been annotated as *Eutaxia* sp. Wogar! (*A. Gunness et al. s.n.* 21/10/2000) but this phrase name has not been recorded on FloraBase.

### 1.5. *Eutaxia inuncta* C.F. Wilkins & Chappill, *sp. nov.*

*E. majori* affinis sed calyce nitido et foliis latioribus, pagina superiore folii costa ad apice lata facta differt.

*Typus:* West of Esperance, Western Australia [precise locality withheld for conservation reasons], 18 September 2000, *J.A. Chappill, M.D. Crisp & L. Cook* 6474 (*holo:* PERTH 07831579!; *iso:* CANB!, MEL!).



Figure 6. Flowering stem of *Eutaxia hirsuta* (scan of section of holotype PERTH 05802644); scale bar = 1 cm.

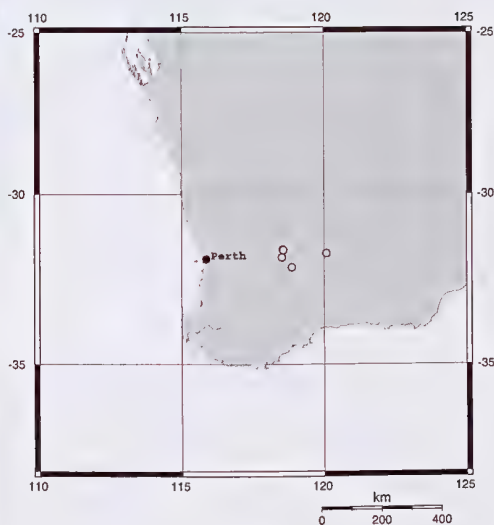


Figure 7. Distribution of *Eutaxia hirsuta* in Western Australia.

*Eutaxia neurocalyx* (Turcz.) Chappill & G.R. Henderson subsp. *major* Chappill & G.R. Henderson ms, Western Australian Herbarium, in FloraBase, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

*Shrub* erect or spreading, sparsely branching 0.15–1.3 × 0.3 m. *Stems* red-brown, without tubercles, not spinescent, with dense, spreading, straight hairs, 0.1–0.2 mm long. *Stipules* mainly absent or inconspicuous, c. 0.1 × 0.1 mm. *Pulvinus* 0.8–1.5 mm long. *Leaves* spreading, alternate, internode length shorter than leaf length; *petiole* 0.15–0.5 mm long; *blade* mainly concolourous, olive green, or discolourous from abaxial surface with red-brown markings, smooth, ovate or narrowly elliptic, 1.8–10.1 × 0.8–3 mm, abaxial surface 1–3-ribbed, (main rib broadening towards the apex), both surfaces glabrous, margin of new growth with sparse to dense, spreading, straight hairs c. 0.15 mm long; the apex acute or obtuse, straight. *Flowers* solitary, axillary, with 3–8 clustered towards the apex of branches on a short or elongated flowering section of stem, 1–18 mm long. *Bracts* similar to floral leaves but broader and thinner-textured, ovate to broadly ovate, 1.5–4.8 × 1.3–4 mm. *Bracteoles* on pedicel at base of calyx, green or orange-brown, ovate to broadly ovate, 2.5–5 × 1.6–3.6 mm; abaxial surface glabrous; adaxial surface with dense spreading, straight hairs c. 0.1 mm long; margin with sparse, spreading, straight hairs c. 0.1 mm long. *Pedicels* straight, 0.1–0.3 mm long. *Buds* excluding emergent petals, (4.5–)5–8.5 × 2.5–3.5 mm, glabrous except for margin of lobes. *Hypanthium* 0.4–0.8 mm long. *Calyx* prominently c. 25-ribbed, pale green glossy, soon becoming orange-brown glossy, without markings; total calyx length (4.5–)5–8.5 mm; three abaxial lobes fused at base for 1.4–2.1 mm, symmetrical, or central lobe slightly longer, 4.6–4.7 × 2–2.5 mm; two adaxial lobes fused at base for 4.4–5 mm, ovate, straight, 1.2–1.7 × 0.9–1.2 mm, the apex acute. *Standard* claw 2.7–3.5 × 0.5–0.6 mm; lamina base truncate with small auricles; yellow-orange or orange with basal yellow eye rimmed by red flares, red veins on rear; lamina ovate, or broadly ovate, rarely elliptic, 6.5–9.3 × 7.6–11 mm, emarginate indent 0.6–0.7 mm long. *Wings* claw 2.5–3 mm long; lamina adaxial spur straight, 0.5–0.8 mm long; lamina dark red base and apical half yellow-orange, straight, or downturned, oblong to obovate,

6–7.8 × 2.2–3 mm; the apex obtuse. *Keel* claw 2–3 mm long; lamina dark red apex, fading to base; straight, oblong, 3.8–4.8 × 1.8–2.4 mm, towards the apex of adaxial margin with scattered hairs c. 0.05 mm long, the apex straight, rounded. *Stamen filaments* 2.3–5.3 × 0.1–0.2 mm; *anthers* white, 0.4–0.5 × 0.3–0.4 mm. *Gynoecium* stipe 0–0.2 mm long; *ovary* 2.3–4.5 × 1.3–2.3 mm, with dense, spreading, straight hairs, c. 0.8 mm long, evenly distributed; *style* hooked towards the apex, 2.4–3.5 × 0.25–0.5 mm, lower half with sparse, spreading, straight hairs c. 0.5 mm long, upper half glabrous; *stigma* capitate. *Fruit* inflated, ellipsoid, placental margin slightly curved, non-placental margin strongly curved, 5.5–5.7 × 2.4–2.7 mm, outer surface with dense, spreading, straight hairs c. 0.8 mm long. *Seeds* brown, ellipsoid, c. 1.6 × 1.4 mm; aril cream, c. 0.8 × 0.3 mm. (Figure 8)

*Chromosome number.*  $2n = 14$  (vouchers Sands 638.17.7, 638.18.2, cited by Sands, 1975 as *Pultenaea neurocalyx*).

*Selected specimens.* WESTERN AUSTRALIA: N of Esperance, 16 Oct. 1931, *W.E. Blackall & C.A. Gardner* 1100 (PERTH); SSE of Kau Rocks, NE of Intersection 3 on Condingup Road, 2 Sep. 1984, *M.A. Burgman & C. Layman* MAB 3336 (PERTH); E of Styles Road on Norwood Road, 16 Sep. 2000, *J.A. Chappill, M.D. Crisp & L. Cook* 6444 (PERTH); Gibsons Soak, 16 Sep. 1934, *C.A. Gardner s.n.* (CANB, PERTH); E of Duke of Orleans Bay Road, 19 Sep. 1976, *R.J. Hnatiuk* 761043 (PERTH); N of Esperance, 15 Oct. 1998, *P.C. Jobson & K.M. Downs* 5830 (CANB, NSW, PERTH); NE of Hopetoun, 2 Nov. 1962, *M.E. Phillips* 24071 (CANB, NSW); N of Esperance, 18 Oct. 1985, *E. & S. Pignatti* 1172 (PERTH); Cape Le Grand National Park, E of Esperance, 21 Oct. 1969, *R.D. Royce* 8725 (PERTH); N of Gibson, N of Esperance, near Esperance Plains Research Station, 23 Oct. 1969, *R.D. Royce* 8850 (PERTH); E of Ravensthorpe, Ravensthorpe to Esperance, 25 Aug. 1963, *V.E. Sands* 638.18.2 (PERTH, SYD); Daniels Road, Ravensthorpe to Hopetoun, 25 Aug. 1963, *V.E. Sands* 638.17.7 (PERTH, SYD); E of Scaddan on Styles Road, 11 Sep. 1984, *P. van der Moezel* PGV 461 (PERTH); W of Esperance, 2 Sep. 1947, *J.H. Willis s.n.* (MEL, PERTH); E of Ravensthorpe, 2 Sep. 1947, *J.H. Willis s.n.* (MEL).

*Distribution and habitat.* *Eutaxia inuncta* is found towards the south coast of Western Australia between Ravensthorpe and Cape Arid (Figure 9). It has been collected in low open heath on sandy soil.

*Flowering period.* August to November.

*Conservation status.* This species is widespread and is not considered to be under threat at this time.

*Etymology.* From the Latin *inunctus* (as if oiled), referring to the glossy mature calyx.

*Notes.* *Eutaxia inuncta* is similar to *E. neurocalyx*, *E. major*, *E. hirsuta* and *E. lutea* in having prominently ribbed leaves, bracteoles and calyx. *E. inuncta* is most similar to *E. major* but can be distinguished by the hairs usually present on the stems, the calyx that is glossy and red brown between the ribs, and the broader leaves have a central rib on the lower surface that broadens prominently towards the apex.

## 1.6. *Eutaxia lasiophylla* G.R.Hend., *sp. nov.*

In margine et superficiebus ambabus folii pilis densis, effusis, rectis 0.15–0.2 mm longis, vel pilis densis solum in pagina adaxialis et in margine; calyx rubro-brunneus glaber; stylus crassus, uncinatus; stigma capitatum.





Figure 8. Flowering stem of *Eutaxia inuncta* (scan of section of holotype PERTH 07831579); scale bar = 1 cm.

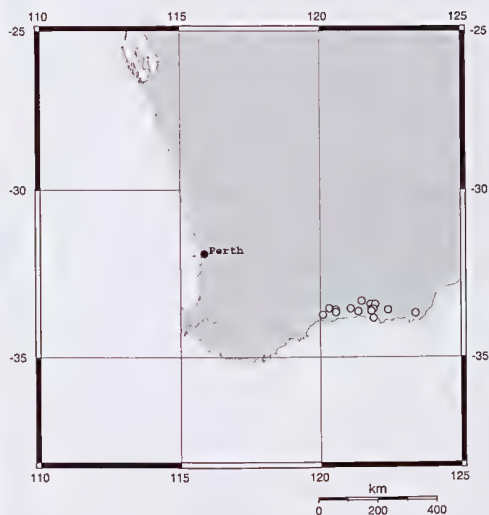


Figure 9. Distribution of *Eutaxia inuncta* in Western Australia.

*Typus*: NW of Southern Cross on Bullfinch Road, Western Australia [precise locality withheld for conservation reasons], 10 September 2000, J.A. Chappill 6410 (*holo*: PERTH 07684541!; *iso*: CANB!, K!, NSW!).

*Shrub* erect, densely branched, 0.1–0.8 × 0.15–0.8 m. *Stems* red-brown, without tubercles, not spinescent, with dense, spreading, straight hairs *c.* 0.15 mm long. *Stipules* absent. *Pulvinus* 0.2–0.3 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole* 0.1–0.25 mm long; *blade* concolorous, olive green to grey-green, not tuberculate, oblong, or narrowly ovate, (0.8)–2–4.5 × 0.8–1 mm, abaxial surface ribs absent or distinctly 1- or 3-ribbed, both surfaces and margin with dense, spreading, straight hairs 0.15–0.2 mm long, or dense hairs only on adaxial surface and margin; the apex rounded, straight. *Flowers* axillary, solitary or in pairs. *Bracts* similar to floral leaves but shorter, broader and thinner-textured, ovate or oblong, 1.3–2.5 × 0.6–2 mm. *Bracteoles* on pedicel just below calyx, red-brown, rarely green, broadly ovate, 1.5–3 × 1.4–2 mm, glabrous or hairs on adaxial surface *c.* 0.1 mm long. *Pedicels* straight, 1–2.5 mm long. *Buds* excluding emergent petals 4.3–8 × 2.5–4 mm, glabrous except for margins of lobes. *Hypanthium* 0.5–0.7 mm long. *Calyx* faintly 6-ribbed, red-brown on older or pressed flowers, without markings or rarely with dark red diffuse spots on adaxial lobes, grey-green throughout on fresh young flowers, dull; total calyx length 4–6 mm, three abaxial lobes fused at base for 1.6–2.6 mm, equal in length, central lobe slightly wider, 2.1–2.7 × 2–2.8 mm; two adaxial lobes fused at base for 3.8–4.3 mm, broadly ovate, straight, 0.5–0.7 × 1.3–1.6 mm, the apex broadly acute, rarely rounded. *Standard* claw 2.7–3.7 × 0.45–0.8 mm; base cordate, not auriculate; lamina orange-yellow with red-brown markings in throat and a bright yellow, oblong eye bordered by a broad halo of orange-red to purple-red markings conspicuous on lower surface; lamina broadly ovate or broadly elliptic, 5.4–6.2 × 10–12.2 mm; emarginate indent 0.5–0.6 mm long. *Wings* claw 2.5–2.8 mm long; lamina adaxial spur curled more or less, 1.5–2 mm long; lamina orange-red, fading to orange-yellow at the apex, straight or downturned, oblong, 6.3–6.8 × 1.8–2.1 mm, the apex rounded to truncate. *Keel* claw 2.2–2.5 mm long; lamina orange-red base, dark red towards the

apex, straight, oblong,  $4.7\text{--}6 \times 2.3\text{--}2.5$  mm, glabrous, the apex rounded to truncate. *Stamen filaments*  $3.5\text{--}5.7 \times 0.2\text{--}0.5$  mm; *anthers* white, c.  $0.4 \times 0.3\text{--}0.35$  mm. *Gynoecium* sessile; *ovary*  $1.2\text{--}1.4 \times 0.5\text{--}0.8$  mm, with sparse, spreading, straight hairs, c. 0.3 mm long on upper half or throughout; *style* hooked towards the apex,  $3.4\text{--}4.3 \times 0.3\text{--}0.4$  mm, lower half sparsely covered with spreading, straight hairs c. 0.5 mm long; *stigma* capitate. *Fruit* and *seed* not seen. (Figure 10)

*Chromosome number*  $2n = 16$  (voucher *James 639.1.1*; cited as *E. microphylla* by Sands 1975)

*Selected specimens.* WESTERN AUSTRALIA: Bronti plains, just E of Southern Cross, between Southern Cross and Kalgoorlie, 5 Oct. 1931, *W.E. Blackall & C.A. Gardner* 880 (PERTH); from Moorine Rock toward Perth, along Great Eastern Highway, 10 Sep. 1968, *E.M. Canning* WA/68 2681 (CANB); W of Bodallin, Sep. 1990, *J.A. Chappill* 1071 (PERTH); E of Lake O'Connor Road on Hyden-Norseman Road, 20 Sep. 1999, *J.A. Chappill* 6224 (PERTH); Smythe Road, S of Yerbillion, 8 Sep. 2000, *J.A. Chappill, L. Cobb & H. Ngo* 6404 (PERTH); E of Carrabin by road, 12 Sep. 1976, *R. Coveny & B. Habersley* RC 8358 (K, NSW, PERTH); W of Forrestania X-roads, 10 October 2003, *G.F. Craig* 5895 (PERTH); SW of Bodallin, 16 Sep. 1982, *R.J. Cranfield* 2450 (PERTH); Flint's Farm NE of Hyden, 12 Sep. 2000, *J.M. Flint* 212 (PERTH); Bronti, 1 Oct. 1931, *C.A. Gardner* 2785 (BM, K, PERTH); E of Hyden, 22 Aug. 1998, *G.R. Henderson, J.A. Chappill & R. Butcher* GRH 2 (PERTH); Between Bullfinch and Southern Cross, 3 Sep. 1963, *S.H. James* 639.1.1 (PERTH, SYD); Sandplains Nature Reserve 28940, N of Hackling Road, 28 Sep. 1997, *G.J. Keighery & N. Gibson* 4082 (PERTH); from Southern Cross towards Coolgardie on the Great Eastern Highway, 12 Sep. 1999, *A. Monro, G.T. Chandler & S. Donaldson* AMM 20 (CANB, PERTH); W of Southern Cross, along Great Eastern Highway, 10 Sep. 1968, *M.E. Phillips* WA/68 775 (A, CANB, L); Muntadgin, Sep. 1947, *T.W. Stone & E.T. Bailey* ETB 821 (PERTH).

*Distribution and habitat.* *Eutaxia lasiophylla* is found in inland areas between Muntadgin, Bronti and Lake Cronin (Figure 11). It has been collected in shrubland on white or yellow sand over laterite.

*Flowering period.* August to October.

*Conservation status.* This species is widespread and is not considered to be under threat at this time.

*Etymology.* From the Greek *lasios* (= woolly), and *phyllon* (= leaf) in reference to the hairy leaves present in this species.

*Notes.* This species bears superficial resemblance to *E. microphylla* due to the small ( $< 5$  mm long) opposite and decussate, spreading leaves but it lacks the distinctive elongate, filiform style and simple stigma of that species, having instead a thick, hooked style and capitate stigma. It differs from *E. hirsuta* in its glabrous rather than being a densely hairy calyx without prominent ribs and differs from *E. neurocalyx* in having opposite and decussate rather than being alternate leaves, persistent hairs on the adaxial or both surfaces of the leaf and on the margin, rather than being just on the margin, and in having larger flowers. Specimens collected in northern areas, between Merredin and Southern Cross, have hairs covering the leaves, while specimens collected around Forrestania, east of Hyden, have hairs only on the adaxial surface.

Specimens of this species held at PERTH have been determined as *Eutaxia* sp. Carrabin (*R. Coveny & B. Habersley* 8358) but this name has not been recorded on FloraBase.



Figure 10. Flowering stem of *Eutaxia lasiophylla* (scan of section of holotype PERTH 07684541); scale bar = 1 cm.

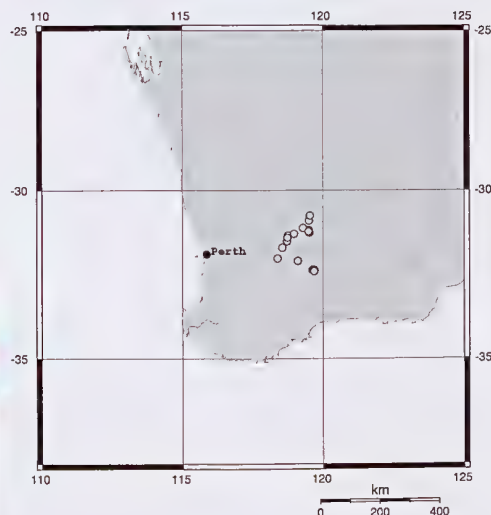


Figure 11. Distribution of *Eutaxia lasiophylla* in Western Australia.

### 1.7. *Eutaxia lutea* Chappill & G.R.Hend., *sp. nov.*

*E. neurocalyx* affinis sed corolla lutea non carina rubra differt.

*Typus*: Cascades Road, towards Lake King from West Point Road, Western Australia, 19 September 1999, *G.T. Chandler, A. Monro & S. Donaldson* 932 (*holo*: PERTH 05916852!; *iso*: AD, CANB, MEL, NSW).

*Shrub* erect or spreading, densely branching, 0.2–0.6 × 0.2–0.5 m. *Stems* pale brown, without tubercles, not spinescent, covered in dense, spreading, minute, straight, white hairs *c.* 0.05 mm long, becoming glabrous at maturity. *Stipules* absent. *Pulvinus* 0.2–0.3 mm long. *Leaves* appressed, alternate or opposite and decussate, internode length shorter than leaf length, *petiole* 0–0.1 mm long; blade concolourous, grey-green, or abaxial surface slightly darker, red-brown diffused, smooth or rarely tuberculate, ovate to linear, 0.6–4 × 0.6–1.6 mm, abaxial surface ribs 1–3 or not visible, blade glabrous, or apical third of abaxial surface and margin with moderately dense, spreading, straight or wavy hairs *c.* 0.1 mm long; the apex obtuse. *Flowers* near apex of stem, axillary, solitary or rarely two per leaf axil. *Bracts* similar to floral leaves but shorter, broader and thinner-textured, ovate, 1.8–3.5 × 1–2.6 mm. *Bracteoles* at base of calyx, green or red-green, ovate, 2.5–4 × 1.1–2.6 mm, glabrous, or abaxial surface and margins with scattered, spreading, straight hairs *c.* 0.15 mm. *Pedicels* straight, 0–0.25 mm long. *Buds* excluding emergent petals, 3–4.5 × 1.7–2.5 mm, outer surface glabrous except for lobe margins or rarely with scattered, white hairs to 0.2 mm long on upper third of lobe. *Hypanthium* 0.4–0.6 mm long. *Calyx* prominently 15–25-ribbed, red-brown, without markings, dull or rarely glossy, total length 3–4.5 mm; three abaxial lobes fused at base for 1.3–1.7 mm, middle abaxial lobe 2.6–2.7 × 1.4–1.5 mm, lateral lobes 2.3 × 1.2–1.3 mm; two adaxial lobes fused at base for 2–2.9 mm, ovate, straight, 0.8–1.3 × 0.8–1.3 mm, the apex acute. *Standard* claw 1.8–2.3 × 0.4–0.6 mm; lamina base rounded, auricles absent; lamina yellow-orange with red flare or pale pink tinge in throat; lamina



elliptic,  $4\text{--}5.5 \times 4.8\text{--}6.1$  mm, emarginate indent  $0.2\text{--}0.3$  mm. *Wings* claw  $1.7\text{--}2.1$  mm long; lamina adaxial spur straight,  $0.3\text{--}1.1$  mm; lamina yellow-orange, base with tinge of pink, straight, oblong to slightly obovate,  $3.5\text{--}4.6 \times 1.3\text{--}1.9$  mm, the apex obtuse. *Keel* claw  $1.4\text{--}2.1$  mm long; lamina yellow-orange, base with tinge of pink, straight, oblong,  $3.5\text{--}4.7 \times 1.5\text{--}2.3$  mm, glabrous, the apex obtuse. *Stamen filaments*  $2\text{--}4.7 \times 0.25\text{--}0.3$  mm; *anthers* cream to yellow,  $0.3\text{--}0.5 \times 0.2\text{--}0.4$  mm. *Gynoecium* sessile; *ovary*  $0.9\text{--}1.7 \times 0.35\text{--}0.7$  mm, with dense, spreading, straight hairs, *c.*  $0.5$  mm long evenly distributed; *style* hooked towards apex,  $1.9\text{--}2.8 \times 0.2\text{--}0.25$  mm, lower third with sparse, spreading, straight hairs *c.*  $0.2$  mm long, glabrous above; *stigma* capitate. *Fruit* inflated, placental margin slightly curved, non-placental margin strongly curved, (immature) *c.*  $3.3 \times 2$  mm, outer surface with dense, appressed, white hairs throughout, to  $0.2$  mm long. *Seeds* not seen. (Figure 12)

*Selected specimens.* WESTERN AUSTRALIA: NW of Mt Heywood, 16 Oct. 1970, *T.E.H. Aplin* 4132 (NSW, PERTH); Sparkle Hill, W of Mt Ragged, 18 Oct. 1970, *T.E.H. Aplin* 4259 (MEL, PERTH); S of Truslove, N of Esperance), 15 Oct. 1931, *W.E. Blackall* 1044 (PERTH); Gravel pit, WNW of Bald Rock, 2 Oct. 1983, *M.A. Burgman & S. McNee* MAB 2647 (PERTH); E of Muckinwobert Rock, 3 Oct. 1983, *M.A. Burgman & S. McNee* MAB 2690 (PERTH); NW of Munglinup, 7 Nov. 1998, *J.A. Chappill & R. Butcher* JAC 6100 (PERTH); E of Salmon Gums, 28 Oct. 1999, *J.A. Chappill & C.F. Wilkins* JAC 6273 (PERTH); W of Lort River, 29 Oct. 1999, *J.A. Chappill & C.F. Wilkins* JAC 6305 (PERTH); Fields Road, N of Bishop's Road, 29 Oct. 1999, *J.A. Chappill & C.F. Wilkins* JAC 6306 (PERTH); E of Wittenoom Road on Greens Road, S of Mt Burdett, 25 Sep. 1992, *G.F. Craig* GFC 2238 (ESP, GFC, PERTH); NNW of Young River crossing on Ravensthorpe-Esperance main road, 15 Oct. 1968, *E.N. Jackson* 1425 (AD, PERTH); Truslove Road, E of Cox Road, E of Truslove, 6 Nov. 1992, *T.D. Macfarlane & H.R. White* TDM 2130 (CANB, PERTH); S of Peak Charles, 9 Nov. 1979, *K.R. Newbey* 6426 (PERTH); S of Scaddan, N of Esperance, 23 Oct. 1969, *R.D. Royce* 8864 (NSW, PERTH); NE of Scaddan on Cox Road, 16 Oct. 1982, *P. van der Moezel* PGV 206 (PERTH).

*Distribution and habitat.* *Eutaxia lutea* is known from Peak Charles north-east of Ravensthorpe to Sparkle Hill, west of Mt Ragged (Figure 13), in shrubland or mallee woodland, on deep white or grey sand, brown gravelly clay, or white, grey or brown sandy clay over limestone.

*Flowering period.* September to November.

*Conservation status.* This species is widespread and not considered to be under threat at this time.

*Etymology.* From the Latin *lutea* (= yellow) in reference to the all yellow-orange corolla of this species.

*Notes.* *Eutaxia lutea* differs from *E. neurocalyx* in having an all yellow-orange corolla without a red keel.

Specimens of this species held at PERTH have been determined as *Eutaxia* sp. Cascades Road (G.T. Chandler *et al.* 932), but this name has not been recorded on Western Australian Herbarium in *FloraBase*.

### 1.8. *Eutaxia major* (Benth.) C.F. Wilkins & Chappill, *stat. nov.*

*Pultenaea neurocalyx* Turcz. var. *major* Benth., *Fl. Austral.* 2: 130 (Oct. 1864). *Type citation*: 'Phillips Ranges, Mount Bland, Robertson's Brook, etc., Maxwell.' *Lecto, here designated*: Around a spring



Figure 12. Flowering stem of *Eutaxia lutea* (scan of section of holotype PERTH 05916852); scale bar = 1 cm.

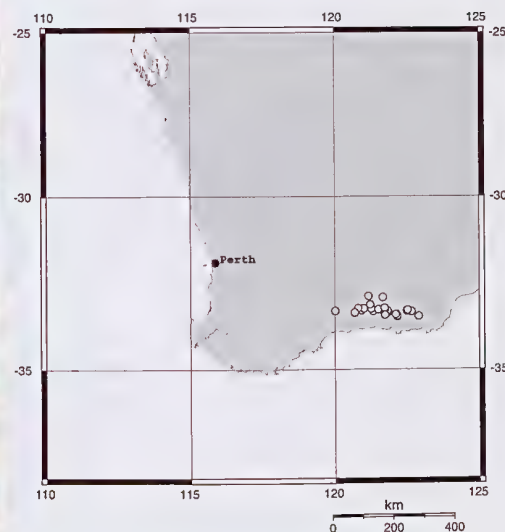


Figure 13. Distribution of *Eutaxia lutea* in Western Australia.

near the base of the south side of Mount Bland, [Western Australia], *s. dat.*, *G. Maxwell s.n.* (MEL 35245!). *Paralecto*: Phillips Ranges, *s. dat.*, *G. Maxwell s.n.* (?K, central specimen (image PERTH!); MEL 1519200!). Robertson's Brook, *s. dat.*, *G. Maxwell s.n.*, (MEL 625017!) [= *E. inuncta*].

*Eutaxia neurocalyx* (Turcz.) Chappill & G.R. Henderson subsp. *leptophylla* Chappill & G.R. Henderson ms, Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.au> [accessed 12 November 2008].

*Shrub* erect, spindly, sparsely branching, 0.2–1 × 0.2–1 m. *Stems* green or pale red, with cream ribs, without tubercles, not spinescent, glabrous (flowering section of stem glabrous or with dense, spreading, straight hairs 0.05–0.4 mm long). *Stipules* absent or rarely cream, *c.* 0.1 × 0.1 mm. *Pulvinus* 0.5–1.0 mm long. *Leaves* appressed or spreading, alternate or rarely opposite, internode length shorter than leaf length; *petiole* 0.1–0.3 mm long; *blade* concolourous, pale grey-green, mainly narrowly elliptic, linear, or ovate, 1.3–9 × 0.4–1.2 mm, smooth, abaxial surface distinctly 1–3-ribbed, both surfaces glabrous, margins of young leaves with or without sparse, spreading, straight hairs 0.05–0.1 mm long, the apex acute or rounded, straight. *Flowers* 2–7 in short terminal cluster, or on an elongated flowering section of the stem, 2–12 mm long. *Bracts* similar to floral leaf but shorter, broader and thinner-textured, broadly ovate to ovate, 1.5–5 × 1.4–2.6 mm. *Bracteoles* on pedicel, at base of calyx, pale green or red with cream margins, broadly ovate or ovate, 1.8–2.3 × 1–2 mm, both surfaces glabrous, margin glabrous or with dense, spreading, straight hairs *c.* 0.2 mm long. *Pedicels* straight, 0.2–0.8 mm long. *Buds* excluding emergent petals, 5–8.3 × 1.8–2.5, glabrous except for margin of lobes. *Hypanthium* 0.4–0.5 mm long. *Calyx* prominently 25-nerved, dappled red markings and cream or pale green ribs, dull; total length 5–8.3 mm long; three abaxial lobes fused at base 1.8–2.8 mm, equal length or central lobe slightly longer, 2.6–4 × 1.5–2 mm; two adaxial lobes fused at base for 3.2–5.1 mm, ovate, straight, 0.9–1.7 × 0.9–1.2 mm, the apex acute. *Standard* claw 2.5–3.2 × 0.5–1 mm; lamina base cordate, auriculate or non auriculate; lamina orange-yellow with dark red markings around a triangular, yellow-orange eye; broadly elliptic, or broadly ovate, 6–9 × 8–11.2 mm, emarginate indent

0.2–0.8 mm long. *Wings* claw 1.8–3 mm long; lamina adaxial spur straight, 0.4–0.5 mm long; lamina base red, apical 2/3 orange-yellow, straight or downturned, obovate,  $5.5\text{--}8 \times 1.8\text{--}3$  mm, the apex rounded. *Keel* claw 1.8–2.8 mm long; lamina deep orange-red throughout, straight, oblong,  $3.6\text{--}4.9 \times 2\text{--}2.2$  mm, glabrous, the apex rounded. *Stamen filaments*  $3\text{--}5.8 \times 0.15\text{--}0.2$  mm; *anthers* cream,  $0.4\text{--}0.5 \times 0.3\text{--}0.35$  mm. *Gynoecium* stipe 0.15–0.2 mm long; *ovary*  $1.3\text{--}1.8 \times 0.5\text{--}0.7$  mm, with dense, spreading, straight hairs, c. 0.6 mm long, evenly distributed; *style* hooked just below the apex,  $2.9\text{--}3.9 \times 0.2\text{--}0.5$  mm, with scattered to dense hairs at base, glabrous above; *stigma* capitate. *Fruit* inflated, placental margin slightly curved, non-placental margin strongly curved,  $4.3\text{--}4.8 \times 2.5\text{--}3$  mm, outer surface with medium density, spreading, straight, white hairs 0.4–0.8 mm long. *Seeds* not seen.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: SW of Clyde Hill, 18 Oct. 1970, *T.E.H. Aplin* 4284 (MEL, PERTH); NE of Mt Heywood, 2 Oct. 1995, *W.R. Archer* 2109516 (AD, CANB, HO, MEL, PERTH); West Mt Barren, 16 Oct. 1928, *W.E. Blackall & C.A. Gardner* 2210 (PERTH); Maxwell's lookout, Fitzgerald River National Park, 13 Oct. 1990, *J.A. Chappill* 1506 (PERTH); Near Kau Nature Reserve, NW of Orleans Bay Road-Fisheries Road intersection, 29 Oct. 1999, *J.A. Chappill & C.F. Wilkins* 6283 (PERTH); East Mt Barren, 17 Oct. 1983, *M.G. Corrick* 8762 (MEL, PERTH); NE of Condingup, 10 Oct. 1992, *G. F. Craig* 2317 (PERTH); N of Fisheries Road ESE of Howick, 18 Sep. 1968, *N.N. Donner* 2614 (AD, CANB, K, PERTH); Fitzgerald River National Park, N of Quaalup homestead, 19 Oct. 1991, *W. Greuter* 22971 (PERTH); Rubbish tip area of Hopetoun and power line track E of Ravensthorpe / Hopetoun Road, 25 Oct. 1994, *E.D. Kabay* 908 (PERTH); E along road to Bremer Bay from junction with Gairdner South Road, 12 Oct. 1988, *T.D. Macfarlane* TDM 1848 (PERTH); W of Hopetoun, Sep. 2000, *M. MacMahon* 33 (BRI, PERTH); Western Australia, s.dat., *Maxim s.n.* (NSW); W. Australia, s.dat., *F. von Mueller s.n.* (P); East Mount Barren, WNW of Hopetoun, 4 Oct. 1966, *T.B. Muir* 4178 (MEL); NW of Mt Bland, 23 Sep. 1962, *K.R. Newbey* 492 (PERTH); Fitzgerald River National Park, 24 Oct. 1970, *R.D. Royce* 9303 (PERTH); lower slopes of East Mount Barren, Hamersley Drive, 12 Sep. 1983, *J. Taylor & P. Ollerenshaw* JT 1718 (CANB, PERTH); N of Hopetoun, 13 Aug. 1982, *C.E. Woolcock* 5a (PERTH); Cape Arid, 21 Sep. 1982, *C.E. Woolcock* 5d (PERTH); Swamp Road, Bremer Bay, 15 Sep. 1982, *C.E. Woolcock* 5e (PERTH).

*Distribution and habitat.* *Eutaxia major* is found in Western Australia between Bremer Bay and Cape Arid (Figure 14). It has been collected in open woodland, shrubland or heathland on sandy soil. It is often associated with *Banksia* species.

*Flowering period.* July to November.

*Conservation status.* This species is widespread and is not considered to be under threat at this time.

*Etymology.* From the Latin *major* (= greater), applied by Bentham with reference to the larger flowers and calyx when compared to *E. neurocalyx*.

*Notes.* *Eutaxia major* and *E. inuncta* are distinguished from *E. neurocalyx* in having larger flowers (calyx 5–8.3 mm long). The leaves of *E. major*, while more slender, are similar in shape to those of *E. inuncta*, but *E. major* can be distinguished by having a calyx that is dull dappled red or green with cream ribs rather than being glossy and red-brown throughout, and in the leaf rib on the lower surface being the same width throughout, rather than being much wider towards the apex.



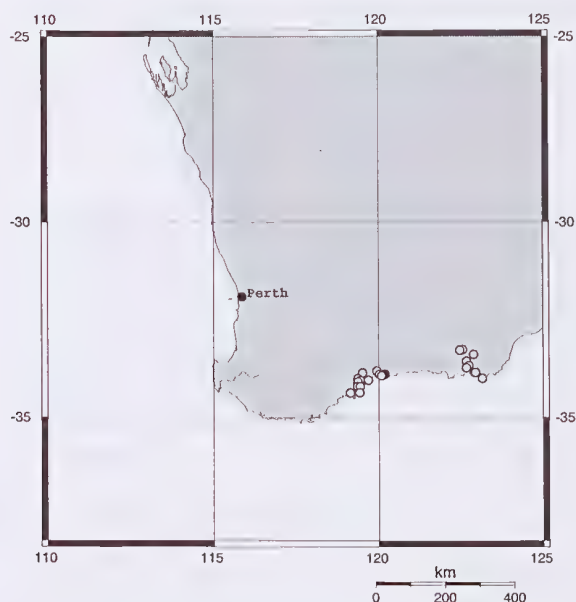


Figure 14. Distribution of *Eutaxia major* in Western Australia.

MEL 35245 has been chosen as the lectotype as it was viewed by Benthham, matches the type description, and has the definite locality of Mt Bland (around a spring near the base of the S side of Mt Bland), rather than the the broadly defined Phillips Range, or a Maxwell collection from no stated locality. The collection from Robertson's Brook (MEL 625017) is referable to *E. imuncta*. A specimen at Kew (image seen; PERTH 01025325) collected by Maxwell and labelled as from 'Phillips Range etc.' appears to be a mixed collection of *E. imuncta* on the lateral specimens and a possible paralectotype of *E. major* as the central specimen. It is, however, impossible to verify this from the poor quality photo.

*Eutaxia baxteri* was described from horticultural material and a type specimen has not been located. The illustration has therefore been chosen as the lectotype.

The epithet *leptophylla*, as used by Chappill and Henderson in the manuscript name *E. neurocalyx* subsp. *leptophylla*, is unavailable at species rank as it is pre-occupied by *Eutaxia leptophylla* Turcz.

**1.9. *Eutaxia myrtifolia* (Sm.) R.Br.**, in Aiton, *Hort. Kewensis* ed 2, 3: 16 (Oct.-Nov. 1811). *Dillwynia myrtifolia* Sm., *Trans. Linn. Soc.* 9: 263 (1808). Type citation: '...found by Mr. Menzies at King George's Sound...I have not seen the fruit.' (holo: LINN; iso: BM 550742!).

*Eutaxia myrtifolia* (Sm.) R.Br. var. *angustifolia* Meisn., in Lehm., *Pl. Preiss.* 2: 216 (Aug. 1848). Type citation: 'Swan River, coll. II. No. 110.' [Western Australia, 1842, *J. Drummond* 2: 110] (lecto, here designated: BM 550738!; isoelecto: CGE, G!, LD, MEL, P!, NSW).

*Dillwynia obovata* Labill., *Nov. Holl. Spec. Plant.* 1: 110, t. 140 (Dec. 1805), *nom. illeg.*, non Turcz. (1853); *Eutaxia obovata* (Labill.) C.A.Gardner, *Enum. Plant. Aust. Occ.*: 61 (July 1930). Type citation: 'HABITAT in terra Van-Leuwin.' [Western Australia] (holo: FI-W; iso: B, BM550741!, FI-W, G!, LINN, P!).

*Eutaxia baxteri* Knowles & Westc., *Floral Cab.* 1: 89, t. 43 (Feb. 1838). *Type citation.* 'Our drawing was taken from a plant in the collection of the Birmingham Botanical and Horticultural Society...a native of New Holland, and was probably raised by Mr. Knight from Mr. Baxter's last importation of seeds in 1830.' (*lecto, here designated:* [icon] *Floral Cab.* 1: t. 43).

*Shrub* erect or rarely prostrate, densely branching 0.5–2.5 × 0.35 m. *Stems* red-brown or green with red tubercles, cream ribbed, not spinescent, glabrous or rarely with sparse, spreading, straight hairs 0.01–0.05 mm long. *Stipules* cream, 0.15–0.4 × 0.1–0.3 mm. *Pulvinus* 0.3–0.8 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length; *petiole* 0.2–1.7 mm long; *blade* concolorous mid-green, or discolorous with abaxial surface red-brown or purple, not tuberculate, obovate, 4.5–21(–27) × 2–6 mm, abaxial surface with one prominent central rib, often one major and two minor, lateral ribs, both surfaces and margin glabrous; the apex acute to acuminate and straight. *Flowers* axillary, 1 or 2 flowers. *Bracts* in the axil of a vegetative leaf, ovate, 0.4–1.3 × 0.3–0.7 mm. *Bracteoles* positioned c. halfway down the pedicel, green or brown, ovate, 0.4–1 × 0.35–0.7 mm, glabrous or towards the apex or margin with scattered, spreading, straight hairs c. 0.01 mm long. *Pedicels* straight, 2–4.8 mm long. *Buds* excluding emergent petals, 3–5 × 1.8–2.5 mm, glabrous except for margins of lobes. *Hypanthium* 0.5–0.8 mm long. *Calyx* inconspicuously 6-ribbed, mid-green without markings or green tube and red markings on lobes, dull; total calyx length 3–5 mm long; three abaxial lobes fused at base for 1.6–2.2 mm, equal length and width, 1.3–2.4 × 0.9–1.2 mm; two adaxial lobes fused at base for 3.6–4.3 mm, broadly ovate, falcate, 0.3–0.5 × 0.9–1.4 mm, the apex obtuse. *Standard* claw 2.2–2.9 × 0.35–0.7 mm; lamina base truncate, auriculate; lamina orange-yellow with a greenish-yellow, ovate eye bordered with a broad halo of red and conspicuous dark red veins absent or present; lamina broadly ovate, 5.8–7.3 × 7.7–9 mm, glabrous, emarginate indent 0.4–0.6 mm long. *Wings* claw 2.5–3 mm long; lamina adaxial spur straight or curved, 0.3–1 mm long; lamina orange-yellow, darker orange-red towards the base, downturned, slightly obovate, 5.4–6 × 1.2–1.9 mm, the apex obtuse to truncate. *Keel* claw 2–2.4 mm long; lamina red, straight, oblong, 4.3–5.2 × 1.5–2.2 mm, glabrous, the apex somewhat acute. *Stamen filaments* 3–5.3 × 0.25–0.4 mm; *anthers* cream, 0.3–0.4 × 0.2–0.3 mm. *Gynoecium* sessile; *ovary* 1.3–1.5 × 0.5–0.6 mm, upper half with moderately dense, spreading, straight hairs, c. 0.8 mm long, lower half with shorter, appressed hairs; *style* hooked towards the apex, 2.9–3.4 × 0.25–0.3 mm, base with scattered white hairs to 0.3 mm long, apical 2/3 glabrous; *stigma* capitate. *Fruit* compressed, placental margin slightly curved, non-placental margin strongly curved, 5–6 × 3–4.8 mm, outer surface with sparse, spreading, wavy hairs c. 0.5 mm long. *Seeds* black, ellipsoid, 1.4–2.1 × 1.1–1.4 mm; aril cream, c. 1 × 0.7 mm.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: Walpole - Nornalup National Park, Ficifolia Road, 19 Nov. 1987, A.R. Annels 2235 (PERTH); Mt Many Peaks, Albany E, 4 Oct. 1994, S. Barrett 25 (PERTH); North Twin Peak Island, Recherche Archipelago, 24 May 1972, M.I.H. Brooker 3679 (PERTH); Porongorups Scenic Drive, E of Narikup Road, 15 Dec. 1990, J.A. Chappill & C.F. Wilkins JAC 1370 (PERTH); Walk trail Cape le Grande to Hellfire Bay, 15 Dec. 1990, J.A. Chappill & C.F. Wilkins JAC 1870 (PERTH); Cape Leeuwin, Jan. 1956, D. Churchill 17 (PERTH); Water Catchment Reserve, off Bettys Beach Road, Albany E, 11 Aug. 1984, E.J. Croxford 3382 (PERTH); NNW Northcliffe, 12 Mar. 1997, R. Davis 2820 (PERTH); Willyung Hill, N of Albany, 23 Sep. 1984, D.B. Foreman 834 (CANB, MEL, PERTH); Yallingup, 22 Sep. 1940, C.A. Gardner s.n. (PERTH); S of Milyeannup Coast Road, NE of intersection with Roberts Road, 25 Oct. 1990, N. Gibson & M. Lyons 979 (PERTH); Torbay Head area, West Cape Howe National Park, 25 May 1991, N. Gibson & M. Lyons 664 (PERTH); Hassell Beach, S of southern end of beach (Cheynes Beach), 22 Aug. 1979, L. Haegi 1851 (K, NSW, PERTH); N along Gardiner River Road from Chesapeake Road, 18 Mar. 1997, K. Kershaw & C. Day

P 91.6 (PERTH); Mt Elphinstone, Albany W, 4 Oct. 1986, *M.E. Nash s.n.* (PERTH); SW of East Mt Barren, Fitzgerald River National Park, 2 Nov. 1976, *K.R. Newbey* 4912 (PERTH); High Island in the Duke of Orleans Bay, 20 Oct. 1985, *E. & S. Pignatti* 1248 (CANB, PERTH); Dunsborough, 16 Oct. 1949, *R.D. Royce* 3171 (PERTH); At Tagon Harbour, Cape Arid National Park, E of Esperance, 3 Dec. 1971, *R.D. Royce* 10042 (PERTH); Karridale, 24 Oct. 1953, *R.D. Royce* 4673 (PERTH); Frenchman Bay, SE of Albany, 8 Sep. 1967, *P.G. Wilson* 6244 (CANB, PERTH).

*Distribution and habitat.* Endemic to the south-west of Western Australia, *E. myrtifolia* has been collected from coastal regions and islands off the coast between Cape Naturaliste and Cape Arid. Collections at PERTH said to be from Kenwick (*Meebold* 11655) and Ongerup (*Hassell s.n.*), and from MEL said to be from Pinjarra (*Mueller s.n.*) have not been verified. There are no records from the Stirling Range although it is common in the Porongorup Range (Figure 15). This species has been collected from heath, shrubland and open woodland on clay, loam or commonly sand over granite. Associated species include *Eucalyptus patens*, *E. marginata*, *E. megacarpa*, *Corymbia calophylla*, *Agonis flexuosa* and *A. parviceps*.

*Flowering period.* April to November.

*Conservation status.* This species is widespread and not considered to be under threat at this time.

*Etymology.* The specific epithet refers to the myrtle-like leaves present in this species.

*Notes.* This species has a strong resemblance to *E. cuneata*, sharing with this species the distinctive

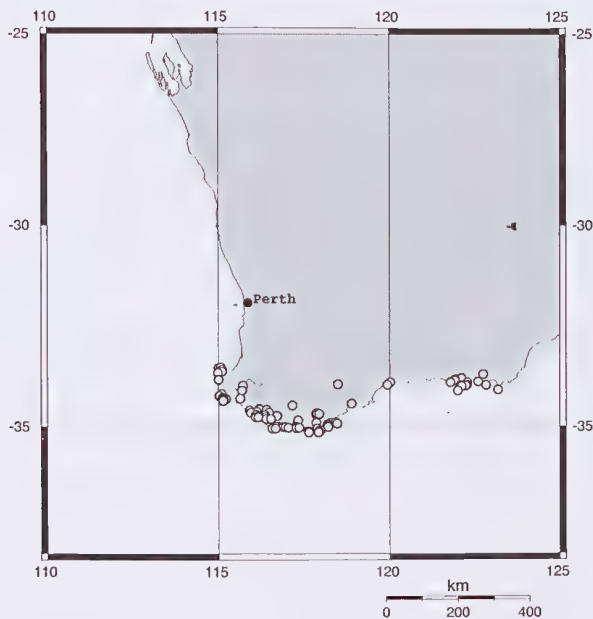


Figure 15. Distribution of *Eutaxia myrtifolia* in Western Australia.



truncate adaxial calyx lip and small (c. 1 mm long), ovate bracteoles positioned towards the middle of the pedicels. The two species can be differentiated by their leaf forms. Although *E. myrtifolia* exhibits a range of leaf densities and shapes, they are always more or less obovate with a distinct acute or acuminate apex. Specimens from coastal areas tend to have broader, upward-pointed leaves, while those from forest areas tend to have narrower, outspread leaves.

BM 550738, from Shuttleworth's Herbarium, is selected as the lectotype of *E. myrtifolia* (Sm.) R.Br. var. *angustifolia* Meisn. as it is annotated by Meissner, unlike duplicates of this collection at CGE and LD (M.D. Crisp pers. comm. 2009). Meissner is known to have accessed collections by James Drummond in Shuttleworth's Herbarium (Crisp 1983). There is another specimen on BM 550738 (bottom RH corner) collected by Gilbert and not annotated by Meissner.

The original description of *E. baxteri* was based on a plant grown from seed thought to have been collected by William Baxter. A type specimen has not been located and so the illustration is chosen as a suitable lectotype.

#### 1.10. *Eutaxia neurocalyx* (Turcz.) Chappill & G.R.Hend., *comb. nov.*

*Pultenaea neurocalyx* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 26 (1): 281 (1853). *Type citation*: 'Drum. coll. V: 63' [Western Australia, 1847–1849, *J. Drummond* 5: 63] (*holo*: KW; *iso*: G! K, MEL 35248!, P!, PERTH 01026267!, 01025864!).

*Shrub* erect or spreading, sparsely branching, 0.2–0.5 × 0.2–1 m. *Stems* without tubercles, pale brown with dense, spreading or appressed, straight, wavy, or papillose, hairs, 0.05–0.5 mm long, not spinescent. *Stipules* absent. *Pulvinus* 0.2–0.7 mm long. *Leaves* spreading or appressed to stem, alternate, rarely opposite and decussate, internode length shorter than leaf length; *petiole* 0.05–0.2 mm long; *blade* ovate, not tuberculate, concolourous olive green or grey green, or slightly discolourous with abaxial surface slightly darker, without purple markings, 0.8–2.5(–4) × 0.7–1(–1.5) mm, abaxial surface distinctly, ribs absent or 1–3, both surfaces glabrous, margins of new growth with sparse to dense, spreading, straight hairs 0.1–0.3 mm long, the apex obtuse, straight. *Flowers* axillary, solitary or paired, or with 2–7 flowers clustered together towards the apex of branchlet on a compressed or elongate flowering section of the stem 2–5 mm long. *Bracts* similar to floral leaf but shorter and often broader and thinner-textured, ovate, 1.3–3 × 0.8–1.8 mm. *Bracteoles* at base of calyx, ovate-lanceolate, 1.3–3 × 0.8–2 mm, green becoming orange-brown, margin with sparse, spreading, straight hairs c. 0.1 mm long. *Pedicels* straight, 0.1–0.3 mm long. *Buds* excluding emergent petals 3.6–5 × 1.8–2.5 mm, glabrous, except for hairs on margin of lobes. *Hypanthium* 0.4–0.7 mm long. *Calyx* prominently 15–25-ribbed, green becoming orange-brown without markings, matt or glossy; total length 3.6–5 mm long; three abaxial lobes fused at base for 1–2.2 mm, equal length and equal width, or central slightly wider than laterals, 2.2–3.8 × 1–1.5 mm; two adaxial lobes fused at base for 2.5–3.7 mm, straight, 0.8–1.2 × 0.6–1 mm, the apex acute. *Standard* claw 1.8–3.5 × 0.4–0.8 mm; lamina base truncate to slightly cordate, auriculate or auricles absent; lamina yellow-orange, basal eye ovate, yellow-green, bordered by a halo of dark red veins conspicuous on rear, broadly ovate, 5.5–8 × 6.1–10 mm; emarginate indent 0.1–0.5 mm long. *Wings* claw 1.8–3 mm long; lamina adaxial spur distinctly hooked, or straight, 0.5–1.3 mm long; lamina yellow-orange, infused with red at the base, downturned, slightly obovate, 4.3–6.5 × 1.2–2.1 mm, the apex rounded to truncate. *Keel* claw 1.5–2.7 mm long; lamina orange or red, fading towards the base, oblong, 3–4.2 × 1.3–1.9 mm, adaxial margin glabrous or with scattered to medium density hairs to 0.05 mm long, the apex obtuse. *Stamen filaments* 1.8–5 × 0.15–0.4 mm; *anthers* pale cream, 0.3–0.5 × 0.25–0.3 mm. *Gynoecium* stipe 0.1–0.3 mm long; *ovary* 1.5–1.8 × 0.6–0.7 mm, with dense, spreading, straight hairs, c. 0.6 mm long, evenly distributed; *style* hooked

towards the apex,  $1.8-3 \times 0.25-0.35$  mm, lower half with sparse, spreading, straight hairs c. 0.5 mm long, upper half glabrous; *stigma* capitate. *Fruit* inflated, ellipsoid, placental margin slightly curved, non-placental margin strongly curved,  $3-4 \times 2.4-2.5$  mm, outer surface covered with straight, dense, spreading, straight hairs c. 0.8 mm long. *Seeds* immature.

*Chromosome number.* Unknown.

*Etymology.* From the Greek *neuron* (= nerve) and *calyx*, in reference to the prominently ribbed calyx present in this species.

### 1.10.a. *Eutaxia neurocalyx* subsp. *neurocalyx*

*Leaves* spreading, longer than other subspecies, 1.5–3 (4) mm long; *keel* adaxial margin glabrous, *stem* with dense, curly or straight hairs c. 0.5 mm long.

*Selected specimens.* WESTERN AUSTRALIA: Boolanelling Nature Reserve, 3 Sep. 1998, *E. Bennett* BO 6.38 (PERTH); S of Harrismith in Toolibin catchment, 23 Nov. 1999, *E. Bennett & T. Sleep* 4.010 A (PERTH); Nature Reserve no. 36598, SSW Kulin on Grays Road, 8 Oct. 1984, *J.M. Brown* 135 (PERTH); E of Forrestania crossroads on road to Norseman, 17 Oct. 1984, *J.M. Brown* 165 (PERTH); E of Williams Road, Quairading area, 4 Nov. 1998, *J.A. Chappill & R. Butcher* 6048 (PERTH); Holden Road off Tarin Rock Road W, 23 Oct. 1986, *E.J. Croxford* 5324 (PERTH); Gravel Reserve, near Kulin Road turnoff, Harrismith-Lake Grace Road, 21 Oct. 1986, *E.J. Croxford* 5340 (PERTH); Lukin's property, SE of Kukerin, 14 Oct. 2003, *J. Gray* 158 (PERTH); NE of Mt Barberton on North Woogenilup Road to South Stirlings, 26 Oct. 1985, *G.J. Keighery* 7315 (AD, CANB, PERTH); South Stirling Nature Reserve, 24 Oct. 1991, *G.J. Keighery* 12582 (PERTH); WNW of Chillinup Pool, 17 Sep. 1974, *K.R. Newbey* 4378 (PERTH); E of Lake Grace township, 25 Sep. 1983, *J. Taylor & P. Ollerenshaw* 2262 (MEL).

*Distribution and habitat.* This subspecies occurs in Western Australia from Harrismith to east of Forrestania and south to Chillinup Pool and South Stirling Ranges (Figure 16). It is found in mallee heath or *Allocasuarina* shrubland, in yellow or grey sand over clay, or brown sandy gravel soil over laterite.

*Flowering period.* September to November.

*Conservation status.* This subspecies is widespread and has no special conservation needs at this time.

*Notes.* Differs from *E. neurocalyx* subsp. *nacta* and *E. neurocalyx* subsp. *papillosa* in having spreading rather than having appressed leaves that are mostly longer and with more incurved margins, and in having a glabrous keel.

### 1.10.b. *Eutaxia neurocalyx* subsp. *nacta* C.F. Wilkins, subsp. nov.

*Caulis* pilis densis ad 0.4 mm longis; *folia* parva, ad caulem appressa, margo adaxialis carinae pilis albis ad 0.1 mm longis ornatus.

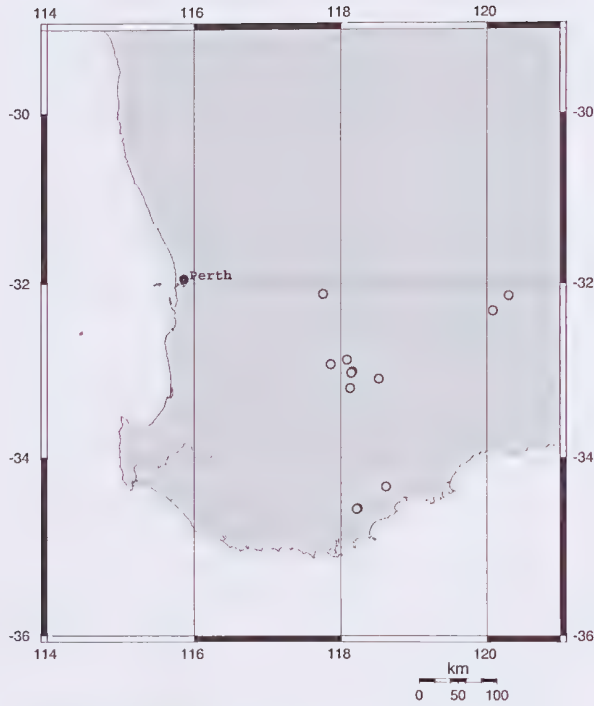


Figure 16. Distribution of *Eutaxia neurocalyx* subsp. *neurocalyx* in Western Australia.

*Typus*: south-south-west of Queen Victoria Rocks, Western Australia [precise locality withheld for conservation reasons], 24 September 1993, *G.J. Keighery* 12,976 (*holo*: PERTH 04187415; *iso*: CANB).

*Stem* with dense hairs to 0.4 mm long; *leaves* small (< 1.5 mm long) and appressed close to stem, *keel* adaxial margin with white hairs to 0.1 mm long. (Figure 17)

*Selected specimens*. WESTERN AUSTRALIA: [localities withheld] 11 Sep. 1962, *T.E.H. Aplin* 1962 (PERTH); Nov. 1971, *W.H. Butler* s.n. (PERTH); 15 Sep. 1999, *G.T. Chandler*, *A. Monro* & *S. Donaldson* GTC 879 (CANB, PERTH); Sep. 1934, *C.A. Gardner* s.n. (BM, K, PERTH); 7 May 1992, *A.S. George* 16936 (CANB, PERTH); 25 Oct. 1978, *T.F. Houston* 210-6 (PERTH); 1892, *E. Merrall* s.n. (MEL); 7 Dec. 1987, *J. Pierce* 463 (PERTH); 8 Sep. 1976, *T. & J. Whaite* 4074 (NSW).

*Distribution and habitat*. This subspecies is distributed from Karalee, east of Southern Cross to McDermid Rock which is N of the Bremer Range (Figure 18). It is found in *Callitris preissii* tall open shrubland, and *Allocasuarina* heath with scattered mallee and *Acacia*, in flat plains of deep yellow-red loamy sand, yellow sand or gravelly sand.

*Flowering period*. May to November.

*Conservation status*. Recently listed as Priority Three under DEC Conservation Codes for Western Australian Flora.



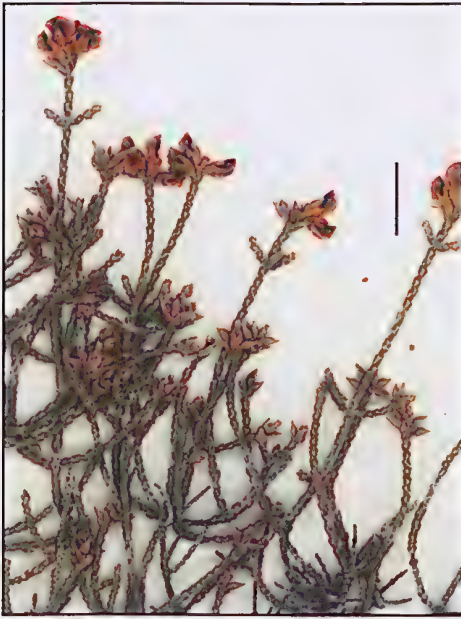


Figure 17. Flowering stem of *Eutaxia neurocalyx* subsp. *nacta* (scan of section of holotype PERTH 04187415); scale bar = 1 cm.

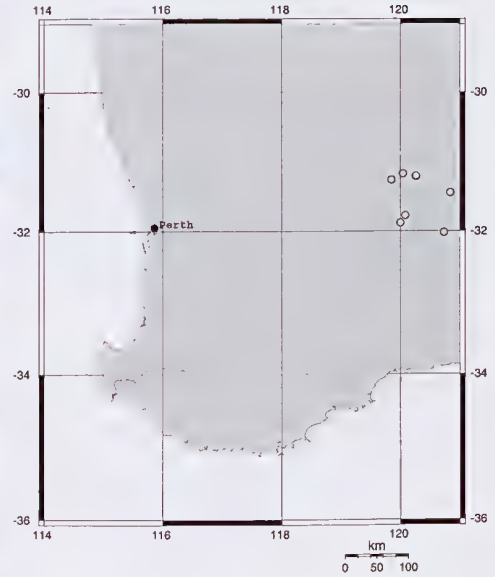


Figure 18. Distribution of *Eutaxia neurocalyx* subsp. *nacta* in Western Australia.

**Etymology.** From the Greek *naktos* (= pressed close) in reference to the closely appressed leaves present in this subspecies.

**Notes.** This subspecies is similar to *E. neurocalyx* subsp. *papillosa* in having small, ovate, appressed leaves and keel marginal hairs, but differs in having woolly hairs covering the stem, rather than having short, white papillose hairs. Both differ from *E. neurocalyx* subsp. *neurocalyx* which has spreading leaves and a glabrous keel.

#### 1.10.c. *Eutaxia neurocalyx* subsp. *papillosa* C.F. Wilkins, *subsp. nov.*

Caulis papillis brevis densis albis ad 0.05 mm longis instructus; folia ad caulem appressa vel vix effusa; margo adaxialis carinae pilis ad 0.1 mm longis indutus.

*Stem* with dense, short, white, papillose hairs to 0.05 mm long; *leaves* mainly < 1.5 (–2) mm long, appressed to stem or slightly spreading; *keel* adaxial margin with hairs to 0.1 mm long. (Figure 19).

*Typus*: 74 km W of Kumarl which is ca 122 km N of Esperance, Western Australia, 10 October 1966, P.G. Wilson 5706 (*holo*: PERTH! 01751786; *iso*: CANB!, MEL!, NSW!).

**Selected specimens.** WESTERN AUSTRALIA: SE of Merredin near Koonadgin, 21 Sep. 1995, *H. Adamson* 8100 (PERTH); Norseman-Lake King Track, E of Lake King Store, 6 Oct. 2001, *B. Archer* 1995 (CANB, MEL, PERTH); Newdegate, 17 Nov. 1931, *W.E. Blackall* 1294 (PERTH); from Newdegate towards Lake Grace, 7 Nov. 1968, *E.M. Canning* 7376 (NSW); Dragon Rocks Nature Reserve, 24 Oct. 1991, *A.M. Coates* 3308 (PERTH); E of Bungalbin Hill, 8 Sep. 1989, *R.J. Cranfield & P.J. Spencer*

7778 (PERTH); W of Newdegate PO, 28 Sep. 1993, *M.D. Crisp & W. Keys* 8525 (CANB, GAUBA, PERTH); Kodj Kodjin Nature Reserve, N of Kellerberrin, 23 Sep. 1986, *L. Darlington s.n.* (PERTH); E of Southern Cross on Great Eastern Hwy, 7 May 1992, *A.S. George* 16936 (CANB, PERTH); Comitun Dam Nature Reserve, ESE of Kellerberrin, 1 Oct. 1997, *G.J. Keighery & N. Gibson* 5832 (PERTH); SSW Queen Victoria Rock, 24 Sep. 1993, *G.J. Keighery* 12976 (PERTH); E of Hyden on road to Forrestania crossroads, 18 Oct. 1995, *B.J. Lepschi* 2169 (PERTH); E of Lake King, 22 Oct. 1991, *T.D. Macfarlane* TDM 1983 (PERTH); N Bungulla Reserve, NW of Kellerberrin, 30 Aug. 1977, *B.G. Muir* 285 (3.4) (PERTH); WNW of Kumarl, on Kumarl-Lake King Road, 10 Oct. 1966, *T.B. Muir* 4381 (MEL); E of Lake Grace, 12 Nov. 1963, *K.R. Newbey* 1029 (PERTH); E of Hyden, 14 Oct. 1963, *K.R. Newbey* 3038 (PERTH); S of Mt Correll, NNW of Bullfinch, 24 Sep. 1982, *K.R. Newbey* 9586 (PERTH); NE of Bungalbin, 18 Sep. 1991, *B.H. Smith* 1530 (CANB, K, MEL, PERTH, S).

*Distribution and habitat.* This subspecies occurs in Western Australia from NNW of Bullfinch to Newdegate (Figure 20). It is found in mainly yellow, creamy-white, or red brown sand, brown or greenish clay with gravel, or gravelly soil over massive ironstone, in *Grevillea* heath or mallee and tall shrubland.

*Flowering period.* August to November.

*Conservation status.* This subspecies is widespread and has no special conservation needs at this time.

*Etymology.* From the Latin *papillosus* (= covered with papillae) is in reference to the papillose hairs present on the stem in this subspecies.

*Notes.* This subspecies is similar to *E. neurocalyx* subsp. *nacta* in having small (1–2 mm long) ovate to elliptic, mainly appressed leaves, and the adaxial margin of the keel with minute, white hairs to 0.1 mm long, but differs in having stem hairs that are papillose and to 0.05 mm long rather than having long hairs to 0.4 mm long. *Eutaxia neurocalyx* subsp. *neurocalyx* has more spreading, mainly longer leaves and a glabrous keel margin. There is one old collection (*T.E. George* 114), from near Yunderup that resembles *E. neurocalyx* subsp. *papillosa* in having a hairy keel margin and papillose stem, that needs recollection for positive identification as it would be a significant range extension.

**1.11. *Eutaxia parvifolia* Benth., *Enum. Pl. [Endlicher]*: 34 (Apr. 1837). Type citation:** ‘King Georges Sound. (Hügel).’ (*holo*: W).

*Eutaxia dillwynioides* Meisn., in Lehm., *Pl. Preiss.* 1: 63 (Sep. 1844). Type citation: ‘In regionibus interioribus Australiae meridionali-occidentalis, m. Oct. 1840. Herb. Preiss. No. 1191.’ (*lecto*, here designated: LD; *isolecto*: NY (image!), P!).

*Eutaxia densifolia* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 26: 271 (1853). Type citation: ‘Drummond V. n. 76.’ [Western Australia, 1847–1849, *J. Drummond* 5: 76] (*holo*: KW; *iso*: BM 550737!, E, G!, K (image!); MEL, NSW, P!, PERTH!, W).

*Eutaxia obovata* Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 26: 271 (1853). Type citation: ‘Drum. V. n. 46.’ [Western Australia, 1847–1849, *J. Drummond* 5: 76] (*holo*: KW; *iso*: BM550736!, G!, K (image!); MEL, NSW, W).



Figure 19. Flowering stem of *Eutaxia neurocalyx* subsp. *papillosa* (scan of section of holotype PERTH 01751786); scale bar = 1 cm.

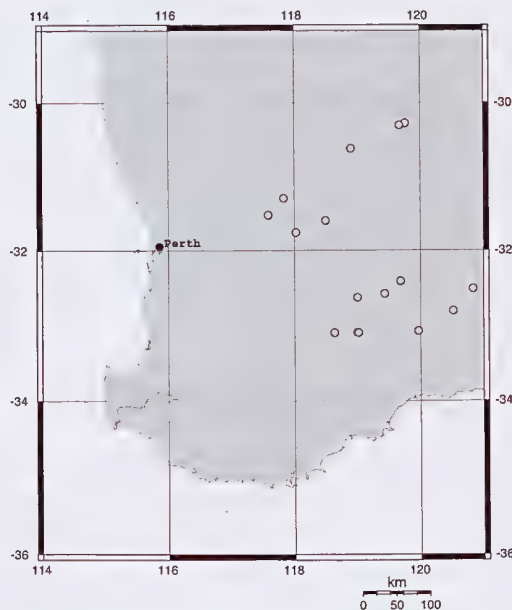


Figure 20. Distribution of *Eutaxia neurocalyx* subsp. *papillosa* in Western Australia.

*Dillwynia incerta* Domin, *Vestn. Král. České Společn. Nauk, Tr. Mat.-Prír.*, 2: 37 (1923). Type citation: 'W.A. [Western Australia]: Warrunup Hill. Stirling Range, leg. Capt. A.A. Dorrien-Smith.' (*holo*: K (image !); *iso*: PERTH!).

*Shrub* erect or prostrate, densely branching 0.2–2 × 0.2–1.4 m. *Stems* red-brown with or without green spots, not or rarely glaucous, without tubercles, not spinescent, glabrous. *Stipules* red-brown, 0.1–0.3 × 0.1–0.15 mm. *Pulvinus* 0.3–0.8 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole* 1–3 mm long; blade concolourous olive green, or abaxial surface slightly darker, not tuberculate, obovate to elliptic, narrowly obovate, 2.5–17 × 1–3 mm, abaxial surface, ribs mainly 1, rarely absent or 2–3, both surfaces and margin glabrous; the apex obtuse to acuminate and apiculate and straight. *Flowers* axillary, solitary, often crowded towards the apex of the branches. *Bracts* similar to floral leaf but shorter and often broader and thinner-textured, but mainly the flower is subtended by a vegetative leaf. *Bracteoles* on upper portion of pedicel, green, lanceolate to narrowly elliptic, 2–4 × 0.5–1.4 mm, glabrous. *Pedicels* straight or recurved, 1–2.4(–4) mm long. *Buds* excluding emergent petals 2.8–5 × 1.6–2.5 mm, glabrous except for margins of lobes. *Hypanthium* 0.35–0.5 mm long. *Calyx* unribbed or with 6 faint veins, red-brown without markings, or green with red markings at junction of free lobes and tube, slightly glossy or dull; three abaxial lobes fused at base for 1.3–1.5 mm, symmetrical, 2.4–3.1 × 0.9–1.1 mm; two adaxial lobes fused at base for 2.4–3.1 mm, ovate, straight, 1.1–1.4 × 0.9–1.1 mm, the apex acute. *Standard*



claw 1.9–2.8 × 0.45–0.8 mm; lamina base cordate, auriculate; lamina yellow or orange-yellow with a yellow ovate eye bordered by a broad halo of orange-red, red vein markings prominent on back, broadly ovate to broadly elliptic, 4–6.1 × 7.1–9.1 mm, emarginate indent 0.4–0.9 mm long. *Wings* claw 1.8–2.3 mm long; lamina adaxial spur straight, or curved, 0.6–0.8 mm long; lamina yellow or orange-red fading to yellow at the apex, downturned, oblong, or obovate, 4.4–6.5 × 1.7–2 mm, the apex obtuse to truncate. *Keel* claw 1.6–2.1 mm long; lamina yellow-cream with apical third red or all red, straight, obovate, 3.4–3.8 × 1.3–1.8 mm, glabrous, the apex acute. *Stamen filaments* 2.3–4.5 × 0.1–0.4 mm; *anthers* white to yellow, 0.35–0.4 × 0.2–0.35 mm. *Gynoecium* stipe 0.4–0.9 mm long; *ovary* 1.3–1.8 × 0.45–0.6 mm, lower half glabrous, upper half with moderately dense, spreading, straight hairs, 0.4–0.5 mm long; *style* hooked towards the apex, 1.8–2.6 × 0.17–0.28 mm, lower half with sparse, spreading, straight hairs c. 0.2 mm long, upper half glabrous; *stigma* capitate. *Fruit* compressed, ellipsoid, placental margin slightly curved or straight, non-placental margin strongly curved, 4.5–7 × 2–3.5 mm, outer surface with sparse, spreading and appressed, wavy hairs c. 0.6 mm long. *Seed* mid-brown to dark brown, ellipsoid, 1.1–1.8 × 1.1–1.6 mm; aril u-shaped, white, c. 0.8 × 0.3 mm.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: Granite Peak walk trail, 29 Sep. 1994, *A.R. Annels* 4527 (CANB, PERTH); Tarin Rock, 24 Sep. 1974, *T.E.H. Aplin* 6013 (AD, MEL, PERTH); Tenterden, 7 Oct. 1967, *A.M. Ashby* 2347 (CANB, K, PERTH); From Shannon R Settlement towards Walpole, 14 Oct. 1968, *E.M. Canning s.n.* (CANB); W of Peaceful Bay Road, on S Coast Highway, 11 Oct. 1997, *J.A. Chappill & R. Butcher* 5900 (PERTH); Near corner of Ledge Point Road and Gull Rock Road, 28 Nov. 2000, *J.A. Chappill & C.F. Wilkins* 6552 (PERTH); Cape Arid National Park, Tagon Road. S of its junction with Merivale Road, 25 Sep. 1985, *M.G. Corrick* 9534 (CANB, MEL); Mount Many Peaks, 20 Oct. 1985, *M.G. Corrick* 9708 (CANB, MEL); Mount Trio, vicinity of car park, 30 Oct. 1986, *R.S. Cowan* A-491 (AD, CANB, MEL, PERTH); Stirling Range, SE of Wedge Hill, 24 Sep. 1979, *M.D. Crisp* 6120 (CANB, NSW, PERTH); Bremer Bay, W of Wellstead turnoff, 4 Oct. 2002, *M.D. Crisp* 9503 (CANB); E from Bow bridge, 19 Sep. 1992, *B.G. Hammersley* 630 (PERTH); Bow River, Nov. 1912, *S.W. Jackson s.n.* (NSW, PERTH); Valley of the Giants Road, 25 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* 3664 (PERTH); Hatter Hill, 3 Sep. 1970, *K.R. Newbey* 3348 (PERTH); N of Cheyne Inlet, off Sandalwood Road, 8 Aug. 1974, *G. Perry* 244 (AD, BRI, NSW, PERTH); N of Gracetown, 4 Nov. 2000, *J. Scott* 302 (PERTH); E of Esperance, near Munglignup Creek, 30 Sep. 1968, *P.G. Wilson* 8074 (CANB, PERTH); Nuyts Wilderness, Walpole-Nornalup National Park, 28 Oct. 1994, *A. Worz* 04.10.28.08 (PERTH).

*Distribution and habitat.* This species is widespread from Bolgart to Albany and east to Cape Arid (Figure 21). It occurs in heathland and open woodland on sand.

*Flowering period.* July to November.

*Conservation status.* This species is widespread with no special needs for conservation at this time.

*Etymology.* From the Latin *parvus* (= small) and *folius* (= leaved) in reference to the small leaves mainly present in this species.

*Notes.* The leaf form of *E. parvifolia* can approach that of both *E. cuneata* and *E. myrtifolia*, but it can be easily distinguished from these species by the two acuminate rather than truncate adaxial calyx

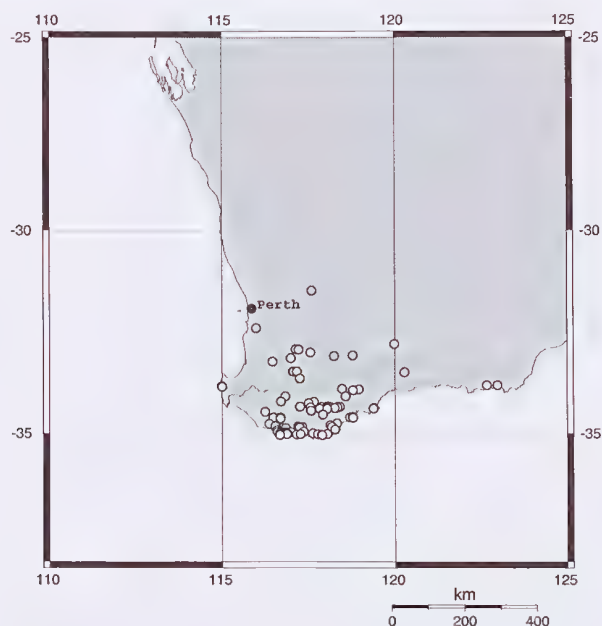


Figure 21. Distribution of *Eutaxia parvifolia* in Western Australia.

lobes and long, lanceolate bracteoles. The flowers are superficially similar to those of *E. microphylla* but differ in their thick and hooked, rather than filiform and elongate style, and capitate rather than simple stigma. The leaf form is highly variable, ranging from less than 5 mm long and cuneate to over 10 mm long and oblanceolate. Specimens collected in inland areas generally have smaller leaves, while specimens with long, narrow leaves similar to the type of *E. densifolia* are found near Albany and in the Stirling Ranges. The continuous range of leaf variation does not allow separate recognition of the *densifolia* or *obovata* Turcz. forms, as leaves often curl inwards when pressed, giving the superficial appearance of a linear leaf. This species does, however, warrant a more detailed examination than was possible in this revision.

*Eutaxia dillwynioides* has been confused with *Dillwynia dillwynioides* (Meisn.) Druce (Grieve 1998), although Meissner's description of glabrous branchlets and dark brown membranous calyx differs markedly from the villous branchlets and calyx of the latter species. No specimens that are labelled *E. dillwynioides* are housed at the Western Australian Herbarium, but two were uncovered amongst loans from the Paris herbarium, one of which was labelled with the collection number of the type specimen cited by Meissner in the original description. This specimen showed little resemblance to *D. dillwynioides*, instead matching *E. parvifolia*. The second specimen was different again, matching the description of *E. microphylla*. *Aotus dillwynioides* Meisn., described in the same publication as *E. dillwynioides*, is synonymous with *D. dillwynioides*.

*Eutaxia dillwynioides* has been lectotypified on the Lund specimen (Crisp 1983 and Crisp pers. comm. 2009) because the material at Lund is of a superior quality to that at NY.

*Dillwynia incerta* Domin was collected by A.A. Dorrien-Smith. A Kew specimen has been chosen as the lectotype. Domin worked with the Dorrien-Smith specimens in Kew. The sheets in K (there are

two) have been annotated, possibly by Gardner, as the 'type' of the name. One corner of one sheet is cut off and an annotation slip says 'specimen presented to W. Australia herbarium'. The complete specimen without the corner cut off is the chosen lectotype. No specimen by this collector are known in Prague (pers. comm. M. Crisp 2009).

**1.12. *Eutaxia virgata* Benth., *Enum. Pl. [Endlicher]:* 34 (Apr. 1837). Type citation:** 'Swan River. [Western Australia] (Huegel)' (*holo*: W; *iso*: K (image!)).

*Eutaxia ericoides* Meisn., in Lehm., *Pl. Preiss.* 1: 63 (Sep. 1844). Type citation: 'In colonia ad fluv. Cygnorum legit Jac. Drummond, n. 245 et coll. 1.' *Lecto, here designated:* Swan River [Western Australia], 1839 [1835–1838], *J. Drummonds.n.* (BM 550739!); *isolecto*: BM 550740! G!, K (image!). *Paralecto*: [Western Australia, 1842], *J. Drummond* 2: 245 (BM 550739!, A, E, G!, K (image!), MEL, P!, W).

*Eutaxia ericoides* Meisn. var. *filicaulis* Meisn., in Lehm., *Pl. Preiss.* 1: 64 (Sep. 1844). Type citation: 'In dumetis arenosis ad fl. Cygnorum, d. 9. Apr. 1839. Herb. Preiss. No. 877.' (*lecto, here designated:* LD; *isolecto*: G!, GH, GOET, K (image!), MEL 2048986, NY (image!), P!, S, W).

*Shrub* erect, spreading or semi-prostrate, often straggly, sparsely branching 0.15–1.5 × 0.1–1.2 m. *Stems* red-brown or green, slight tubercles present or absent, not spinescent, glabrous. *Stipules* absent or cream or green, 0.05–0.3 × 0.05–0.15 mm. *Pulvinus* 0.15–0.4 mm long. *Leaves* spreading, or appressed towards the apex of branchlet, opposite and decussate, internode length mainly longer or shorter than leaf length; *petiole* 0.15–0.4 mm long; *blade* discolourous, pale green over mid green, abaxial surface with or without purple markings; very narrowly obovate, oblanceolate to almost linear, 1.8–15 × 0.5–2 mm, smooth, ribs absent or 1- or 3-ribbed, both surfaces and margin glabrous; the apex acute to somewhat rounded and straight. *Flowers* axillary, 1 or 2 or rarely 3 together. *Bract* narrowly ovate, to ovate, 1.5–2.1 × 0.6–1.6 mm, in the axil of a shorter and thinner-textured floral leaf; or the flower rarely subtended by a vegetative leaf and bract absent. *Bracteoles* mid pedicel, green or red-brown, narrowly ovate, 1.7–3.7 × 0.5–1.2 mm, without ribs, glabrous or few hairs on the apex. *Pedicels* straight, rarely recurved, 1–4.5 mm long. *Buds* excluding emergent petals 3.3–5.5 × 1.9–2.2 mm, outer surface glabrous, except for margins of lobes. *Hypanthium* 0.25–0.5 mm long. *Calyx* inconspicuously 6-ribbed; green with dark red blotches or red-brown, dull; three abaxial lobes fused at base for 1.8–1.9 mm, symmetrical, 2.2–2.9 × 1–1.2 mm; two adaxial lobes fused at base for 3.5–3.7 mm, ovate, straight or slightly falcate, 1–1.4 × 0.9–1 mm, the apex acute. *Standard* claw 3.2–3.7 × 0.6–0.9 mm; lamina base truncate, attenuate or slightly cordate, not auriculate; lamina yellow-orange with red markings on back, with an orange-red or yellow oblong-ovate eye bordered by a broad halo of dark maroon red; lamina broadly ovate to orbicular, 5.8–6.6 × 6.5–9.8 mm, emarginate indent 0.6–0.7 mm. *Wings* claw 2–3.5 mm long; lamina adaxial spur straight, 0.4–1.2 mm long; lamina yellow-orange at the apex, red in the centre fading to cream at the base, straight, oblong, or slightly obovate, 6.1–6.5 × 1.7–1.8 mm, the apex rounded to truncate. *Keel* claw 2–3 mm long; lamina dark red, orange-yellow, base cream or green infused with pink; outside edge straight, inside edge gently curved, 4–4.3 × 1.5–1.8 mm, glabrous, the apex rounded to truncate. *Stamen filaments* 3–5.7 × 0.25–0.3 mm; *anthers* cream, 0.35–0.5 × 0.3–0.35 mm. *Gynoecium* sessile; *ovary* 1.3–2.3 × 0.4–0.6 mm, basal half glabrous, upper half with moderately dense, spreading, straight hairs, c. 0.7 mm long; *style* hooked towards the apex, 2.3–2.9 × 0.2–0.3 mm, glabrous; *stigma* capitate. *Fruit* compressed, placental margin slightly curved, non-placental margin strongly curved, 5.7–7.1 × 2.5–3.3 mm, outer surface with scattered, appressed, straight hairs c. 0.5 mm long. *Seed* black, ellipsoid, 1.8–2.2 × 1.2–1.4 mm; aril u-shaped attached around hilum, c. 1 × 0.4 mm, cream.



*Chromosome number.*  $2n = 16$  (vouchers Sands 638.10.4 and Sands 638.12.10; cited by Sands 1975).

*Selected specimens.* WESTERN AUSTRALIA: Nornalup Road, N of Northumberland Road, WNW of Denmark, 30 Oct. 1991, *A.R. Annels* ARA 1875 (PERTH); North of Wilgarrup siding, SW corner of loc. 12588, 17 Oct. 1994, *A.R. Annels* ARA 4657 (CANB, PERTH); Yallingup, Dec. 1930, *W.E. Blackall* s.n. (PERTH); From Perth towards Brookton, along Brookton Hwy, 7 Oct. 1968, *E.M. Canning* EMC 6048 (A, CANB, L, PERTH); N of Rosa Brook Road on Neilson Road, 10 Dec. 1996, *N. Casson & A. Annels* SC 58.5 (PERTH); N of SW Highway on Corio Road, 11 Nov. 1998, *J.A. Chappill & R. Butcher* 6156 (PERTH); Brockman Hwy, E of Karridale, 25 Oct. 1983, *M.G. Corrick* 8926 (CANB, PERTH); Off Railway Reserve, SE of Bowelling, 7 Sep. 1992, *V. Crowley* DKN 318 (PERTH); Radio Mast Hill, Cranbrook, 10 Oct. 1982, *E.J. Croxford* 2273 (PERTH); ESE of Rosa Glen, 21 Sep. 1995, *R. Davis* 215 (PERTH); Gnangara, Oct. 1945, *C.A. Gardner* s.n. (PERTH); NNE of Mandurah, 2 Oct. 1992, *N. Gibson & M.N. Lyons* 1507 (PERTH); Serpentine, 22 Oct. 1899, *R. Helms* s.n. (CANB, NSW, PERTH); SW Brennans Ford, Scott R, E Augusta, 21 Feb. 1982, *G.J. Keighery* 4483 (PERTH); S of Mt Barker, Cephalotus Swamp, 7 Oct. 1978, *K.F. Kenneally* 6930 (PERTH); Along Torbay Road at the western end from South Coast Highway, 28 Oct. 1992, *T.D. Macfarlane, H.R. White* TDM 2085 (PERTH); S of Nannup, 11 Nov. 1969, *V. Mann & A.S. George*, VM 75 (PERTH); Banganup Lake, near Jandakot, 25 Sep. 1970, *B.R. Maslin* 1250 (PERTH); Lane Pool Reserve, W of Treesville, Harris River Flats, Harvey District, 12 Oct. 1989, *J.L. Robson* JLR 494 (PERTH); Capel, 15 Aug. 1963, *V.E. Sands* 638.10.4 (PERTH, SYD); NNW of Mt Johnston, 6 Sep. 1997, *D. Trenowden* 341 (PERTH).

*Distribution and habitat.* Endemic to Western Australia. *Eutaxia virgata* has been collected mostly from coastal regions in the south-western corner of Western Australia, from Perth to Augusta and east to Mt Manypeaks (Figure 22). It is found in swampy areas or in open heath or forest on flat, wet

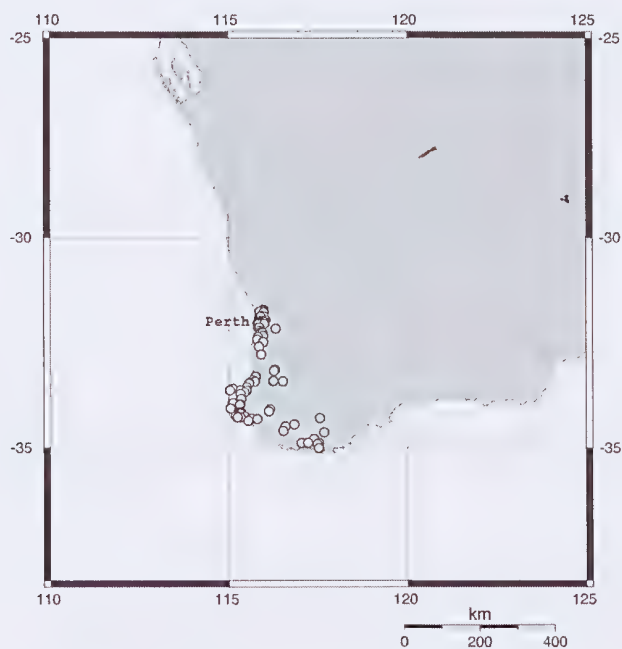


Figure 22. Distribution of *Eutaxia virgata* in Western Australia.

sandy or clay soil. Associated species include *Eucalyptus marginata*, *Corymbia calophylla*, *Agonis linearifolia*, *A. parviceps*, *Melaleuca preissiana* and other *Melaleuca* species.

*Flowering period.* Flowers throughout the year.

*Conservation status.* This species is widespread with no special conservation needs at this time.

*Etymology.* From the Latin *virgatus* (= long and slender) which describes the habit of this species.

*Notes.* *Eutaxia virgata* is easily identified by its long, slender stems and small, sparse, almost linear leaves. These features are shared only with the taxon called *E. exilis* which has been mistaken for *E. virgata* in the past. *Eutaxia virgata* can be distinguished from *E. exilis* by its larger bracteoles, five compared with 10 calyx ribs, smaller keel petal with a rounded the apex and leaves with a somewhat rounded compared with an acuminate apex.

BM 550740! (right hand side specimens) are here chosen as the lectotype of *Eutaxia ericoides* as they are part of Shuttleworth's collection, which would have been viewed by Meisner, are good quality specimens and match the type description. It is uncertain if the left hand side specimens of Drummond 245 are part of the labelled Shuttleworth collection on the right.

The specimen of *Eutaxia ericoides* Meisn. var. *filicaulis* Meisn. at LD is here designated as the lectotype, following (Crisp 1983 and pers. comm. 2009), as it is of better quality than the material at NY where Meissner was affiliated.

**Eutaxia** section **Sclerothamnus** (R.Br.) F.Muell., *Fragm.* 1: 7 (Mar. 1858).

*Sclerothamnus* R.Br., in Aiton, *Hortus Kewensis* ed. 2, 3: 16 (Oct.–Nov. 1811). *Type:* *Sclerothamnus microphyllus* R.Br.

*Ovary* stipitate (stipe 0.5–2 mm long), usually densely covered in soft hairs; *style* filiform and elongate or bent but never hooked, glabrous; *stigma* simple.

## 2.1. *Eutaxia acanthoclada* G.R.Hend. & Chappill, *sp. nov.*

Frutex prostratus ramulis pungentibus; foliis et calyx glaber; corolla omnino luteo-aurantiaca.

*Typus:* south of Forrestania Crossroads on the Southern Cross – Ironcaps Road, Western Australia [precise locality withheld for conservation purposes], 27 October 1999, J.A. Chappill & C.F. Wilkins JAC 6261 (*holo:* PERTH 07684460!; *iso:* CANB!).

*Eutaxia* sp. Hatter Hill (K.R. Newbey 6532), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

*Shrub* mat-forming, prostrate, cushion-like, much-branched, 6–10 × 10–35 cm. *Stems* glaucous pale red to grey, without tubercles, tips of branchlets prominently spinescent, glabrous. *Stipules* absent or cream 0.05–0.1 × 0.1 mm. *Pulvinus* 0.2–0.5 mm long. *Leaves* spreading, opposite and decussate,

alternate, or irregularly arranged, internode length shorter than leaf length, *petiole* 0.15–0.3 mm long; *blade* concolorous or discolorous, pale grey-green, over darker grey-green, without purple markings on abaxial surface; obovate  $1.5\text{--}4.3 \times 0.8\text{--}1.2$  mm, venation obscure or one vein visible, not tuberculate, both surfaces and margin glabrous, the apex obtuse, straight. *Flowers* axillary, solitary. *Bracts* present in the axil of a full size or smaller vegetative leaf, elliptic or obovate,  $0.8\text{--}1.8 \times 0.55\text{--}0.8$  mm. *Bracteoles* on upper pedicel, red or grey-green, lanceolate,  $0.8\text{--}2 \times 0.3\text{--}0.6$  mm, glabrous. *Pedicels* straight, 2–3.8 mm long. *Buds* excluding emergent petals  $2.3\text{--}3.5 \times 1.1\text{--}1.8$  mm, glabrous except for margins of lobes. *Hypanthium* 0.45–0.7 mm long. *Calyx* venation obscure, pale red-brown without markings, dull; three abaxial lobes fused at base for 0.9–1.3 mm, symmetrical,  $1.8\text{--}2.4 \times 0.8\text{--}1.1$  mm; two adaxial lobes fused at base for 1.2–1.7 mm, equal length and width, ovate to narrowly ovate, straight,  $1.2\text{--}1.9 \times 0.65\text{--}0.9$  mm, the apex acute. *Corolla* entirely yellow-orange, *standard* claw  $1.1\text{--}1.5 \times 0.7$  mm; lamina base cordate or truncate, auriculate; lamina broadly ovate to elliptic,  $3.4\text{--}4.2 \times 5\text{--}6$  mm, emarginate indent 0.2–0.3 mm long. *Wings* claw 1.3–1.4 mm long; lamina adaxial spur straight, *c.*  $0.5 \times 0.3$  mm long; lamina oblong, straight,  $3.7\text{--}4.4 \times 1.3\text{--}1.4$  mm, the apex rounded to truncate. *Keel* claw *c.* 1.5 mm long; lamina ellipsoid, with inside edge straight, outside edge strongly arcuate,  $3.6\text{--}4.2 \times 1.6\text{--}2.3$  mm, glabrous, the apex rounded. *Stamen* filaments  $2.8\text{--}4.7 \times 0.15\text{--}0.2$  mm; *anthers* orange,  $0.4\text{--}0.7 \times 0.3\text{--}0.4$  mm. *Gynoecium* stipe 0.3–0.6 mm long; *ovary*  $1\text{--}1.8 \times 0.6\text{--}0.8$  mm, with dense, spreading, straight hairs *c.* 0.7 mm long, evenly distributed; *style* curved,  $1.8\text{--}3 \times 0.1\text{--}0.15$  mm, glabrous; *stigma* simple. *Fruit* inflated, ellipsoid, placental margin slightly curved, non-placental margin strongly curved,  $3\text{--}4.3 \times 2.1\text{--}3$  mm, outer surface with dense hairs. *Seed* immature, brown, glabrous. (Figure 23)

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] 3 Nov. 1931, *W.E. Blackall* 1270 (PERTH); 27 Oct. 1999, *J.A. Chappill & C.F. Wilkins* 6248 (PERTH); 27 Oct. 1999, *J.A. Chappill & C.F. Wilkins* 6263 (PERTH); 5 Nov. 1998, *J.A. Chappill & R. Butcher* 6071 (PERTH); 31 Oct. 1993, *R.J. Chinnock & G.S. Richmond* RJC 8601 (AD, PERTH); 9 Oct. 1965, *F. Humphreys s.n.* (PERTH); 21 Feb. 2007, *W. Johnston* WJ 099 (MDN, PERTH); 3 Sep. 1970, *K.R. Newbey* 3343 (PERTH); 29 Oct. 1991, *B. Smith* 1587 (MEL); Nov. 1929, *H. Steedman s.n.* (PERTH).

*Distribution and habitat.* Collected from Westonia and in the vicinity of Lake Cronin, Hatters Hill, Mt Gibbs and Mt Madden (Figure 24). Found in *Eucalyptus* woodland areas on clay-loam, well-drained sandy loam or ironstone gravel.

*Flowering period.* September to November.

*Conservation status.* Listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2010).

*Etymology.* From the Greek *acantho* (= spiny), *cladus* (= branch) refers to the pungent apices present on branchlets of this species.

*Notes.* The yellow-orange corolla with no markings in *Eutaxia acanthoclada* is similar to *E. actinophylla* and *E. lasiocalyx*, which also share the same elongate, filiform style, simple stigma and lanceolate bracteoles. *Eutaxia acanthoclada* differs from *E. lasiocalyx* in having a glabrous rather than a hairy calyx and is easily distinguished from *E. actinophylla* and *E. lasiocalyx*, by its prostrate, cushion-like habit and abundant, prominent, spinescent tips to the branchlets.





Figure 23. Flowering stem of *Eutaxia acanthoclada* (scan of section of holotype PERTH 07684460); scale bar = 1 cm.

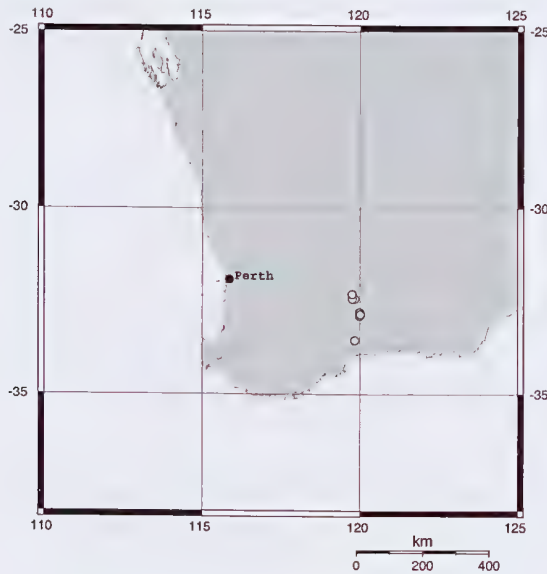


Figure 24. Distribution of *Eutaxia acanthoclada* in Western Australia.

**2.2. *Eutaxia actinophylla*** Chappill & C.F. Wilkins, *Nuytsia* 17: 470–472 (2007). *Type*: new Norseman-Hyden Track, Western Australia [precise locality withheld for conservation reasons], 29 September 1999, B. Archer 1387 (*holo*: PERTH 07463472!; *iso*: CANB, NSW).

*Eutaxia verticillata* Chappill ms., Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

*Shrub* erect, compact 0.15–0.5 × 0.3–0.6 m. *Stems* green or red-brown with yellow ribs, without tubercles, not spinescent, glabrous. *Stipules* absent or cream, 0.05–0.1 × 0.04–0.1 mm. *Pulvinus* c. 0.3 mm long. *Leaves* spreading, in whorls of 3, internode length shorter than leaf length, *petiole* 0.2–0.25 mm long; *blade* concolourous mid-green to grey-green, or purple on abaxial surface, elliptic to obovate, smooth, (1.3–)2–4.5(–6) × 0.5–1.3 mm, abaxial surface with veins not visible or single, leaf glabrous; the apex acute or obtuse and straight. *Flowers* axillary, solitary. *Bracts* absent with flower

in the axil of a vegetative leaf, or the flower subtended by a shorter and thinner-textured floral leaf, ovate, or obovate,  $1.2\text{--}2.9 \times 0.5\text{--}0.9$  mm. *Bracteoles* at base of calyx, green, ovate,  $1\text{--}2 \times 0.5\text{--}1.2$  mm, glabrous, the apex acute. *Pedicels* straight,  $0.8\text{--}1.3$  mm long. *Buds* excluding emergent petals  $3\text{--}4 \times 1.5\text{--}2.8$  mm, glabrous except for margins of lobes. *Hypanthium*  $0.5\text{--}0.6$  mm long. *Calyx* veins not visible or with 5 faint veins, green with red tinge towards the apex and red spots at join of lobes, dull; three abaxial lobes fused at base for  $1.4\text{--}1.6$  mm, symmetrical,  $2\text{--}2.6 \times 1.1\text{--}1.3$  mm, the apex acute; two adaxial lobes valvate, fused at base for  $1.8\text{--}2.6$  mm, ovate, straight,  $1.5\text{--}1.9 \times 1.4\text{--}1.5$  mm, the apex acute. *Standard* claw  $1.1\text{--}1.6 \times 0.6\text{--}0.75$  mm; lamina base cordate, auricles absent; lamina golden-yellow with yellow eye and red flare near base; lamina broadly ovate,  $3.8\text{--}5 \times 6\text{--}7.4$  mm, emarginate indent  $0.4\text{--}0.5$  mm long. *Wings* claw  $0.9\text{--}1.3$  mm long; adaxial spur absent, or straight,  $c. 0.3 \times 0.5$  mm; lamina golden-yellow; oblong, straight,  $3.7\text{--}4.7 \times 1.4\text{--}2$  mm; the apex obtuse. *Keel* claw  $1.1\text{--}1.3$  mm long; lamina lemon-yellow, straight, oblong,  $3.3\text{--}4.7 \times 1.6\text{--}2.8$  mm, glabrous, the apex obtuse. *Stamen filaments*  $2.5\text{--}4.8 \times 0.3\text{--}0.4$  mm; *anthers* cream to yellow,  $0.6\text{--}0.7 \times 0.4\text{--}0.5$  mm. *Gynoeceum* sessile or stipe to  $0.2$  mm long; *ovary*  $1.7\text{--}2.1 \times 0.6\text{--}0.9$  mm, with dense, spreading, straight hairs,  $0.6\text{--}1$  mm long, evenly distributed; *style* filiform, curved,  $1.6\text{--}2.2 \times 0.15\text{--}0.2$  mm, with medium density, spreading, straight hairs  $0.2\text{--}0.7$  mm long on lower third, glabrous above; *stigma* simple. *Fruit* inflated, ellipsoid, both margins strongly curved,  $3.6\text{--}4.8 \times 2.5\text{--}2.6$  mm, with dense, spreading, wavy hairs. *Seeds* black, ellipsoid,  $1.8\text{--}2 \times 1.2\text{--}1.4$  mm; *aril* u-shaped surrounding hilum,  $0.7\text{--}1 \times 1$  mm, translucent white.

*Chromosome number*. Unknown.

*Selected specimens*. WESTERN AUSTRALIA: [localities withheld] 29 Sep. 1999, *B. Archer* 1386 (CANB, MEL, NSW, PERTH); 9 Dec. 2001, *B. Archer* 2071 (MEL, PERTH); 9 Dec. 2001, *B. Archer* 2073 (AD, CANB, MEL, PERTH); 3 Nov. 1990, *W.R. Archer* 3119015 (MEL, PERTH); 10 Oct. 1931, *W.E. Blackall* 995 (PERTH).

*Distribution and habitat*. *Eutaxia actinophylla* occurs in southern Western Australia near Norseman, Salmon Gums and Mt Newmont (Figure 25). This species grows in shrubland on red clay loam with a shallow covering of gravel or in red sandy loam over granite

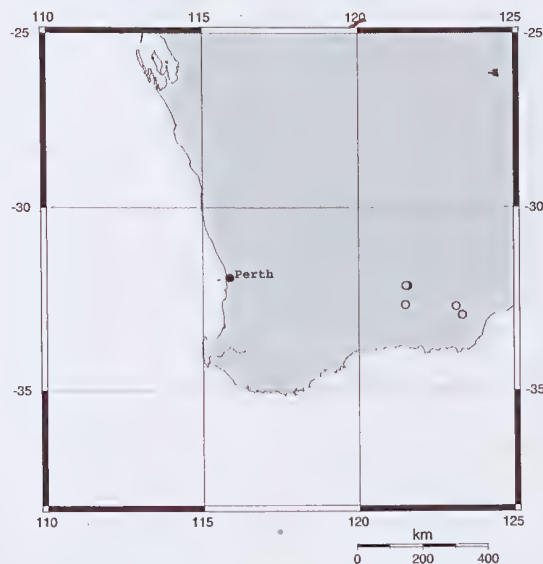


Figure 25. Distribution of *Eutaxia actinophylla* in Western Australia.

*Flowering period.* September to December.

*Conservation status.* Listed as Priority One under DEC Conservation Codes for Western Australian Flora (Smith 2010), as it is only known from a few collections on the Hyden to Norseman track and an old collection at Salmon Gums.

*Etymology.* From the Greek *actinos* (= ray or spoke of wheel) and *phyllon* (= leaf). This species is named for its leaves, which are in regular whorls of three.

*Notes.* *Eutaxia actinophylla* shares the feature of a yellow corolla and glabrous outer surface of the calyx with *E. acanthoclada*; however, in addition to the whorled leaves, it differs in having non-spinescent apices of branchlets and an erect rather than a prostrate habit.

Although previously listed on FloraBase as *Eutaxia verticillata* Chappill ms, this name was not adopted. *Eutaxia* and *Pultenaea* may be combined in the future (Crisp & Cook 2003) under *Pultenaea* Sm. (Orthia *et al.* 2005b) and the epithet is preoccupied in the latter genus as *Pultenaea verticillata* Turcz.

Specimens of this species held at PERTH have been determined as *Eutaxia* sp. Norseman (B. Archer 1977) but this name has not been recorded on FloraBase.

**2.3. *Eutaxia andocada*** Chappill & C.F. Wilkins, *Nuytsia* 17: 471, 474–475 (2007). *Type:* north-east of Peak Charles, Western Australia [precise locality withheld for conservation reasons], 16 September 2000, J.A. Chappill, M.D. Crisp & L. Cook JAC 6439 (*holo:* PERTH 07460392!; *iso:* CANB, NSW).

*Eutaxia* sp. Peak Eleanora (M.A. Burgman 3862), Western Australian Herbarium, in FloraBase, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

*Eutaxia alternifolia* Chappill & C.F. Wilkins ms., Western Australian Herbarium, in FloraBase, <http://florabase.dec.wa.au> [accessed 12 Nov. 2008].

*Shrub* erect, sparsely branching, 0.2–0.4 × 0.3 m. *Stems* reddish brown, smooth, with medium density, spreading, straight hairs *c.* 0.2 mm long, branchlets spinescent. *Stipules* absent or cream, *c.* 0.15 × 0.1 mm. *Pulvinus* 0.2–0.3 mm long. *Leaves* appressed, alternate, internode length shorter than leaf length; *petiole* 0.1–0.25 mm long; *blade* slightly discolourous, adaxial surface pale grey green, abaxial surface with tinge of red; elliptic, rarely obovate, 1.3–4.3(–5) × 0.7–1.8 mm; abaxial surface and margin with scattered, spreading, straight hairs 0.15–0.2 mm long, distinctly 1–3-ribbed and tuberculate; adaxial surface glabrous; the apex obtuse and straight. *Flowers* axillary, solitary. *Bract* absent and flower in the axil of a vegetative leaf, or the flower subtended by a shorter and thinner-textured floral leaf, *c.* 1.7 × 0.8 mm. *Bracteoles* on pedicel, just below the calyx, grey-green, becoming red-brown, ovate-lanceolate or obovate, 0.8–2.1 × 0.3–0.8 mm, glabrous. *Pedicels* straight, 0.7–1.5 mm long. *Buds* excluding emergent petals, 2.6–4.5 × 1.3–1.7 mm, glabrous except for margin of lobes. *Hypanthium* 0.5–0.6 mm long. *Calyx* not prominently ribbed, green with a red tinge, with dark red spots at junction of lobes, dull; total calyx length 2.6–4.5 mm; three abaxial lobes fused at base for 1.1–1.5 mm, symmetrical, middle and lateral lobes 1.4–2.5 × 1.1–1.2 mm; two adaxial lobes fused at base for 1.8–2.8 mm, ovate, straight, 0.9–1.7 × 0.9–1 mm, the apex acute. *Standard* claw 1.4–1.9 × 0.4 mm; lamina base slightly cordate, non-auriculate; lamina yellow-orange with dark



red markings on veins on back, base with pale lemon, ovate to triangular eye with minute orange markings, surrounded by red vein markings; lamina broadly ovate,  $3.5\text{--}5 \times 4.9\text{--}7$  mm; emarginate indent  $0.2\text{--}0.5$  mm long. *Wings* claw  $1.1\text{--}1.9$  mm long; adaxial spur straight,  $c. 0.3 \times 0.3$  mm; lamina straight, yellow-orange with central red marking, oblong,  $4\text{--}5 \times 1.3\text{--}1.7$  mm, the apex rounded. *Keel* claw  $1.1\text{--}2$  mm long; lamina orange-yellow with dark red tip, straight, oblong or slightly obovate,  $3.9\text{--}4.7 \times 1.5\text{--}2.7$  mm, glabrous, the apex rounded. *Stamen filaments*  $3.3\text{--}5.5 \times 0.1\text{--}0.2$  mm; *anthers* cream,  $0.4\text{--}0.5 \times 0.3\text{--}0.35$  mm. *Gynoecium* stipe  $0.5\text{--}1.1$  mm; *ovary*  $1.1\text{--}2 \times 0.6\text{--}0.9$  mm, with evenly distributed dense, spreading, straight hairs  $0.5\text{--}0.8$  mm long; *style* curved,  $2.8\text{--}3.9 \times 0.15\text{--}0.2$  mm, with few scattered hairs at base, glabrous above; *stigma* simple. *Fruit* and *seed* not seen.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] 28 Sep. 1984, M.A. Burgman 3862 (PERTH); 22 Aug. 1995, R. Davis 29 (PERTH).

*Distribution and habitat.* *Eutaxia andocada* is only known from the vicinity of Peak Charles and Peak Eleanora (Figure 26), where it grows in shrubland on white sand or brown sandy clay over granite.

*Flowering period.* August to September.

*Conservation status.* Listed as Priority One under DEC Conservation Codes for Western Australian Flora (Smith 2010).

*Etymology.* From the Greek *andocadon* (= alternately) in reference to the alternate leaves present in this species.

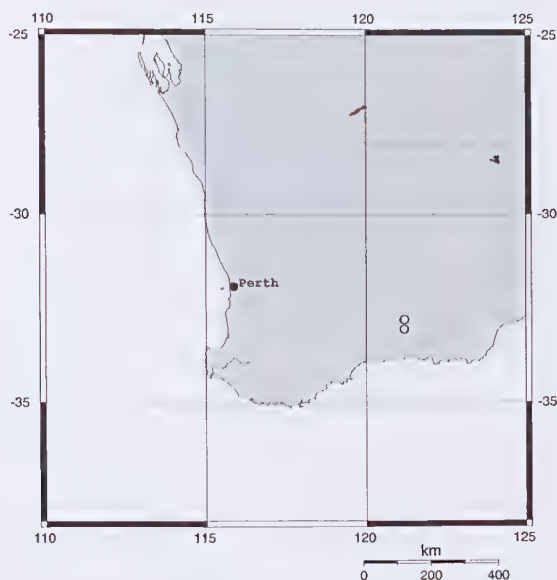


Figure 26. Distribution of *Eutaxia andocada* in Western Australia.

*Notes.* This species differs from *E. microphylla* and *E. rubricarina* in having leaves alternate rather than being opposite, and a keel which is orange-yellow with a dark red tip compared with all red as in *E. rubricarina*.

Although previously listed on FloraBase as *E. alternifolia* Chappill and C.F. Wilkins ms, this name was not adopted as *Eutaxia* and *Daviesia* Sm. may be combined in the future (Crisp & Cook 2003) under *Pultenaea* Sm. (Orthia et al. 2005b) and the epithet is preoccupied in the latter genus as *Daviesia alternifolia* Endl.

**2.4. *Eutaxia diffusa*** F.Muell., *Fragm.* 1 (1): 7 (1858); *Sclerothamnus diffusus* F.Muell., *First Gen. Rep. Gov. Bot. Veg. Colony*: 12 (1853), *nom. nud.*; *Eutaxia virgata* var. *diffusa* Regel, *Suppl. Indicem Seminum [quae Hortus Botanicus Imperialis Petropolitani]*: 37 (1866); *Eutaxia microphylla* var. *diffusa* (F.Muell.) Court, *Vict. Naturalist* 73(10): 173 (1957). *Type citation*: 'In Australia felice et colonia South Australia, a montibus Flinders Range et sinu St. Vincent's Gulf usque ad Murray flumen et tractum Bacchus Marsh.' *Lecto, fide* Court (1957): 'In itinere per plagas interioris S. Aust. monte Mt Remarkable [illegible word] lectus', *s. dat.*, *F. Mueller s.n.* (MEL 624495); *isolecto*: 'interior towards Mt Remarkable Oct. 1850' (K (image!)), on mixed sheet, left hand side, designated *a*, with *paralecto b* on same sheet). *Paralecto*: 'Gawler town' (K (image!)), on mixed sheet, right hand side, designated *b*, with *isolecto a* on same sheet), P!. 'Murray River' (BM 550743!, K). 'Austral. Felix' (K (image!)), P!).

*Shrub* erect, densely branched 0.5–1 × 0.4–1.1 m. *Stems* colour unknown, smooth, glabrous, not spinescent. *Stipules* cream, 0.1–0.15 × 0.1 mm. *Pulvinus* 0.8–1 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length; *petiole* 0.15–0.5 mm long; *blade* strongly discolourous, grey green, over brownish green without purple markings; obovate to narrowly obovate, (2–)4.5–9.7 × (0.8–)1.5–3.7 mm, abaxial surface with veins 3 veins, smooth, both surfaces glabrous, the apex acute, straight. *Flowers* axillary, solitary. *Bract* absent and flower in the axil of a vegetative leaf or bract within vegetative leaf *c.* 1.5 × 0.7 mm. *Bracteoles* on the pedicel just below the calyx, red-green, or green, lanceolate, 1.8–3 × 0.8–1.1 mm, glabrous, the apex acute. *Pedicels* straight, 1.5–3 mm long. *Buds* excluding emergent petals 4.7–4.5 × 2.3–2.8 mm, outer surface glabrous, except for margin of lobes. *Hypanthium* *c.* 0.6–0.8 mm long. *Calyx* faintly 5-ribbed, colour unknown, dull; total calyx length 3.3–5.3 mm; three abaxial lobes fused at base for 1.3–1.6 mm, symmetrical, equal length, 2.2–2.5 × 1.1–1.3 mm; two adaxial lobes fused at base for 2.3–2.8 mm, ovate to narrowly ovate, straight, 1.5–1.7 × 0.9–1.3 mm, the apex acute. *Standard* claw 2.2–3 × 0.4–0.5 mm; lamina base cordate, with or without basal auricles; lamina yellow with or without red veins and or red central markings, broadly ovate, 4.9–6.7 × 7–8.4 mm; emarginate indent 0.5–0.6 mm long. *Wings* claw 2.1–2.5 mm long; lamina yellow, adaxial spur straight, *c.* 0.5 × 0.5 mm; lamina straight, oblong, 5–5.8 × 1.7–2 mm, the apex rounded. *Keel* claw 2.3–2.7 mm long; lamina orange-yellow with darker orange towards the apex, oblong, to elliptic, straight, 5.3–6.2 × 2.3–2.8 mm, glabrous; the apex rounded. *Stamen filaments* 4.7–8.3 × 0.1–0.2 mm; *anthers* cream, 0.6–0.7 × 0.35–0.45 mm. *Gynoecium* stipe 1.2–1.7 mm long; *ovary* 2.3–2.5 × 0.9–1 mm, with evenly distributed dense, spreading, straight hairs, *c.* 0.4 mm long; *style* curved, 3.5–4 × 0.1–0.15 mm, base with sparse, spreading, straight hairs, *c.* 0.2 mm long, remainder glabrous; *stigma* simple. *Fruit* inflated, ellipsoid, both margins strongly curved, 5–6 × 3.3–4 mm, outer surface with dense, appressed, straight hairs, *c.* 0.3 mm long. *Seeds* black, ellipsoid, *c.* 2.5 × 1.8 mm, smooth, shiny; *aril* u-shaped surrounding hilum, *c.* 2 × 0.5 mm, translucent yellow.

*Chromosome number.*  $2n = 16$  (vouchers Sands 649.5.1, 649.6.4 in Sands (1975) as *E. microphylla* var. *diffusa*)

*Selected specimens.* QUEENSLAND: Near Coolmunda Dam, E of Inglewood, 3 Sep. 1975, *L. Pedley* 4235 (BRI). NEW SOUTH WALES: Ingleburn, Sep. 1910, *J.L. Boorman s.n.* (BM, NSW); E along the Quandialla road from the Mid-Western Hwy, near Wyalong, 30 Nov. 1984, *R. Coveny & P. Hind* 12074 (CANB, MEL, NSW, PERTH). VICTORIA: Campbell's Creek, 26 Sep. 1911, *C.H. Derrick s.n.* (G); Southern fringes of the Big Desert N of Lillimur, 24 Sep. 1957, *A.J. Hicks* 102 (K); Little Desert (Parish of Jungkum), NW Victoria, 1 Oct. 1960, *A.J. Hicks* 291 (K); Calder Highway, E of Melbourne, 5 Oct. 1952, *R. Melville, M. Cohn, W. Perry, H. Henkel & J. Kellam* 1458 (MEL, PERTH); Near Bacchus Marsh, 3 Nov. 1910, *J.R. Tovey s.n.* (G); Wimmera, *s.dat.*, *F. von Mueller s.n.* (P). SOUTH AUSTRALIA: S of Swan Reach, ENE of Adelaide, 16, Sep. 1971, *J. Carrick* 2938 (G); Gawler, *s.dat.*, *F. von Mueller s.n.* (P); Kangaroo Island, Brownlow road, W of Kingscote, 5 Sep. 1964, *V.E. Sands* 649.5.1 (PERTH); S of N Hill to Winnian, near Bordertown, 9 Sep. 1964, *V.E. Sands* 649.6.4. (PERTH, SYD). WESTERN AUSTRALIA: S of Ongerup, 26 Sep. 1964, *K. Newbey* 1481 (PERTH).

*Distribution and habitat.* *Eutaxia diffusa* is recorded from Inglewood in Queensland to New South Wales and NW Victoria, and west to South Australia (Figure 27). It is recorded as growing in brown clayey loam with scattered *Eucalyptus behriana*, *Acacia trineura* and *Melaleuca lanceolata*. There is a single collection from S of Ongerup in SE Western Australia (Newbey 1481) but as there have been no further collections from this area, this disjunction would need to be verified.

*Flowering period.* August to October, fruiting in November.

*Conservation status.* This species is widespread and not considered to be under threat at this time.



Figure 27. Distribution of *Eutaxia diffusa* in southern Australia.



**Etymology.** From the Latin *diffusa* (=spreading widely and loosely) possibly refers to the branching habit of the plant, or the less crowded leaves.

**Notes.** *Eutaxia diffusa* differs from *E. empetrifolia* in having leaves with an acute compared with a sub acute apex and a usually longer petiole. It shares with *E. empetrifolia* narrowly obovate to obovate leaves with the leaf base always narrower than the apical third of the leaf. Both species differ in leaf shape from *E. microphylla*, which has ovate or narrowly oblong, or linear elliptic leaves with the truncate base wider or the same width as the apical third of the leaf, an obtuse apex, and leaf margins that are sometimes ciliate compared with always glabrous. The apex of the branchlets of *E. diffusa* are never pungent as seen in many collections of *E. microphylla*.

Before her death, Chappill determined specimens as *E. microphylla* var. *microphylla* or *E. microphylla* var. *diffusa* following Court (1957) and Jessup and Toelken (1986). Harden (2002) and Walsh and Entwistle (1996) give these varieties specific status and this is accepted here. The type form of *S. microphyllus* is distinct from that of *E. diffusa* and the here reinstated *E. empetrifolia*. Due to the complex nature of this group, further research such as DNA sequence analysis of these three species is recommended.

Court (1957) previously lectotypified the Mt Remarkable specimen collected by Mueller (MEL 624495) when he described the variety *Eutaxia microphylla* var. *diffusa* (F. Muell.) Court. It is a large piece of flowering material and the best quality specimen, with a clear label annotated by Bentham. Mueller is known to have sent material to Kew that Bentham had seen so there is a duplicate in K (Herbarium Benthamianum).

**2.5. *Eutaxia empetrifolia* Schltdl., *Linnaea* 20: 667 (1847). Type citation.** ‘An trocknen, sandigen Orten bei Bethanien. November. Blumen orange.’ [Bethany, South Australia, s. *dat.*, H.H. Behr s.n.] (*holo*: HAL?; *iso*: G!).

*Shrub* sprawling to erect, densely branched 0.2–0.5 × 0.4–1 m. *Stems* green with pale cream ribs, without tubercles, glabrous, not spinescent. *Stipules* cream, 0.1–0.15 × 0.1 mm. *Pulvinus* 0.4–0.6 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length; *petiole* 0.05–0.1 mm long; *blade* not discolourous, grey green, without purple markings; narrowly obovate, 0.7–4.5 (–7) × 0.4–1.3 mm, abaxial surface with veins not visible or 1–3 veins, smooth, both surfaces glabrous, the apex subacute to rounded, straight. *Flowers* axillary, solitary. *Bract* absent and flower in the axil of a full size or shorter vegetative leaf. *Bracteoles* on the pedicel just below the calyx, red-green, or green, lanceolate, 1.5–2.3 × 0.6–0.8 mm, glabrous, the apex acute. *Pedicels* straight, 1.3–3.5 mm long. *Buds* excluding emergent petals 2.5–3.8 × 1.3–2.3 mm, outer surface glabrous, except for margin of lobes. *Hypanthium* c. 0.3–0.4 mm long. *Calyx* faintly 5-ribbed, mainly green tube with pale red or red lobes, with or without red spots base of lobes, dull; total calyx length 2.5–3.5 mm; three abaxial lobes fused at base for 1.3–1.6 mm, symmetrical, equal length, 1.7–2.1 × 0.9–1.1 mm; two adaxial lobes fused at base for 1.9–2.1 mm, ovate to narrowly ovate, straight, 1–1.5 × 0.6–0.7 mm, the apex acute. *Standard* claw 1.5–1.9 × 0.3–0.4 mm; lamina base cordate, with or without basal auricles; lamina yellow with red veins and red central markings, broadly ovate, 4.3–5.1 × 5.1–6.6 mm; emarginate indent 0.3–0.6 mm long. *Wings* claw 1.4–1.8 mm long; lamina yellow, adaxial spur straight, c. 0.5 × 0.5 mm; lamina straight, oblong, 4.3–4.5 × 1.4–1.9 mm, the apex rounded. *Keel* claw 1.5–1.8 mm long; lamina yellow with dark red towards the apex, oblong, to elliptic, straight, 3.5–4.3 × 1.9–2.4 mm, glabrous; the apex rounded. *Stamen filaments* 1.8–6.1 × 0.1–0.2 mm; *anthers* cream, 0.5–0.7 × 0.3–0.45 mm. *Gynoeceum* stipe 0.7–1.1 mm long; *ovary* 1.5–1.7 × 0.5–0.7 mm, with evenly distributed dense, spreading, straight hairs, c. 0.4 mm long; *style* curved, 2.4–3.2 × 0.1–0.15 mm, base with sparse,

spreading, straight hairs, c. 0.2 mm long, remainder glabrous; *stigma* simple. *Fruit* inflated, ellipsoid, both margins strongly curved, 3–3.5 × 2.8–4 mm, outer surface with dense, appressed, straight hairs, c. 0.3 mm long. *Seeds* black, ellipsoid, c. 1.5 × 1 mm, smooth, shiny; *aril* u-shaped surrounding hilum, c. 0.8 × 0.6 mm, translucent white.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: Near intersection of Parmango and Howick roads, Reserve 32128, Oct. 1984, M.A. Burgman 4224 (PERTH); Oldfield R crossing on West Point Road, 19 Sep. 1999, G.T. Chandler, A. Monro, S. Donaldson GTC 927 (CANB, PERTH); Lakes Road E of Wagin-Wickepin Road, E of Nomans Lake Hall, 20 Sep. 1999, J.A. Chappill & R. Butcher JAC 6220 (PERTH); NE of old Kundip townsite, 7 Dec. 2003, G.F. Craig 5995 (PERTH); Yillimilling Nature reserve, ENE of Narrogin, 10 Oct. 1996, M.D. Crisp 8918 & W. Keys (CANB, PERTH, MEL); W of Bremer Bay Road along Reef beach Road, 9 Oct. 2002, R. Davis 10453 (MEL, PERTH); Oldfield River at crossing of Esperance – Ravensthorpe Road, 13 Oct. 1968, H.J. Eichler 20237 (AD, CANB, PERTH); Dongolocking Nature Reserve, NE of Wagin, 13 Oct. 1999, G.J. Keighery & N. Gibson 4812 (PERTH); Kamballup along Woogenellup Road, 28 Oct. 1992, T.D. Macfarlane & H.R. White TDM 2090 (PERTH); NE of Howick Hill, Neridup, 21 Sep. 1968, A.E. Orchard 1137 (AD, CANB, PERTH); Cape Arid National Park, camping ground, 9 Sep. 1983, J. Taylor & P. Ollerenshaw JT 1562 (AD, CANB, MEL, PERTH).

*Distribution and habitat.* In South Australia, *Eutaxia empetrifolia* is only recorded from the type specimen collection, and the remainder are from south-western Western Australia (Figure 28). It occurs in tall heath, scrub, shrubland, eucalyptus woodland with low shrub understorey, in light brown sandy clay or sand, on sandstone, in lateritic soil, quartzitic or granitic substrates. The type locality, Bethanien, is the first village established by Lutherans in 1842 at the foot of the Barossa Hills in South Australia.

*Flowering period.* August to October, fruiting in November.

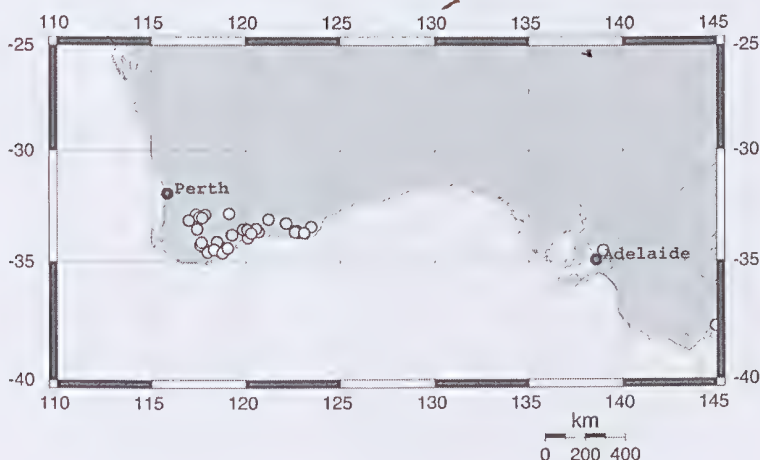


Figure 28. Distribution of *Eutaxia empetrifolia* in southern Australia.

*Conservation status.* This species is widespread and not considered to be under threat at this time.

*Etymology.* Alludes to the superficially similar leaves of the genus *Empetrum* L.

*Notes.* This species differs from *E. microphylla* in having narrowly obovate leaves with a subacute to rounded apex and margins always glabrous, compared with ovate or oblong leaves with an obtuse apex and margins sometimes ciliate. The apex of the branchlets is never pungent as seen in many collections of *E. microphylla*. *Eutaxia empetrifolia* is similar to *E. diffusa* in having obovate leaves, but differs in these being narrow with a rounded to subacute apex instead of acute. Leaves in *E. empetrifolia* are less than 4.5 mm long (mainly 2 mm long) and 1.3 mm wide, compared with (2–) 6–9.7 mm long and up to 2.8 mm wide in *E. diffusa*. Flowers are also mainly smaller.

If *Eutaxia* and *Pultenaea* are combined as *Pultenaea* in the future, it should be noted that the epithet is preoccupied by *P. empetrifolia* Meisn. and the epithet may be changed.

Nicholson included *Eutaxia empetrifolia* Schlecht. in the *Eutaxia* section of *The Illustrated Dictionary of Gardening* 1: 543 (1885) as 'the correct name for the plant described as *Sclerothamnus empetrifolia*.' No records have been found for a previous combination for this name.

**2.6. *Eutaxia lasiocalyx*** Chappill & C.F. Wilkins, *Nuytsia* 17: 476–477 (2007). *Type:* Marvel Loch, Western Australia [precise locality withheld for conservation reasons], 7 November 1984, B.H. Smith 543 (*holo:* PERTH 00710237!; *iso:* CANB, MEL).

*Shrub* spreading, densely branched c. 0.15 × 0.6 m. *Stems* red-brown or green with pale red ribs, tubercles, apical growth with sparse to dense, spreading, straight hairs c. 0.1 mm long, not spinescent. *Stipules* absent. *Pulvinus* 0.2–0.4 mm long. *Leaves* spreading, alternate, or whorled, internode length shorter than leaf length, *petiole* 0.05–0.15 mm long; *blade* slightly discolourous, mid green, over paler green without purple markings; ovate to oblong, verrucose, 0.5–2.2 × 0.35–0.9 mm; abaxial surface with single prominent rib, apical growth with both surfaces and / or margin, with sparse to medium density, spreading, straight hairs c. 0.1 mm long, becoming glabrous, the apex obtuse, straight. *Flowers* axillary, solitary. *Bracts* similar to floral leaves but shorter and thinner-textured, ovate, 0.6–1 × 0.6–1 mm. *Bracteoles* persistent, on the pedicel just below the calyx, red-green, or green, lanceolate, 0.8–1.5 × 0.4–0.6 mm, with sparse, spreading, straight hairs c. 0.15 mm long and hairs on margin, the apex acute. *Pedicels* straight, 0.6–1.7 mm long. *Buds* excluding emergent petals 3–3.8 × 1.3–1.8 mm, outer surface and margin of lobes with medium density, spreading, straight hairs 0.2–0.4 mm long. *Hypanthium* c. 0.6 mm long. *Calyx* faintly 10-ribbed, mainly red tube with green lobes, without markings, dull; total calyx length 3–3.8 mm; three abaxial lobes fused at base for 1–1.2 mm, symmetrical, 1.8–2.5 × 0.7–0.9 mm; two adaxial lobes fused at base for 1.5–1.7 mm, narrowly ovate, straight, 1.4–1.6 × 0.7–0.75 mm, the apex acute. *Standard* claw 1–1.3 × 0.4 mm; lamina base slightly cordate, not auriculate; lamina yellow without markings, broadly ovate or broadly elliptic, 3.5–4.1 × 4.7–6.1 mm, emarginate indent c. 0.3 mm. *Wings* claw 1.1–1.2 mm long; lamina adaxial spur straight, c. 0.3 × 0.4 mm; lamina yellow, straight, oblong, 3.6 × 1.1–1.5 mm, the apex rounded. *Keel* claw 1.2–1.4 mm long; lamina yellow, oblong, straight, 3–3.7 × 1.4–1.8 mm, glabrous; the apex rounded. *Stamen filaments* 2.2–3.3 × 0.15–0.2 mm; *anthers* cream, 0.5–0.6 × 0.3–0.35 mm. *Gynoecium* stipe 0.15–0.3 mm long; *ovary* 1.3–1.5 × 0.5–0.7 mm long, with evenly distributed dense, spreading, straight hairs, c. 0.8 mm long; *style* curved, c. 2.7 × 0.1 mm, base with sparse, spreading, straight hairs, c. 0.2 mm, remainder glabrous; *stigma* simple. *Fruit* and *seeds* not seen.



*Chromosome number.* Unknown.

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] Nov. 1971, *W.H. Butler s.n.* (PERTH); 16 Sep. 1994, *N. Gibson & M. Lyons* 1997 (PERTH); 14 Oct. 2003, *V. Yeomans* 17 (PERTH).

*Distribution and habitat.* *Eutaxia lasiocalyx* is known from the Parker Range, Mt Holland, Forrestania and Lake Barker (Figure 29). It occurs in woodland or mallee on lateritic or quartzitic substrates.

*Flowering period.* September to November.

*Conservation status.* Listed as Priority Two under DEC Conservation Codes for Western Australian Flora (Smith 2010) as it is only known from a few locations, but occurs within a conservation reserve.

*Etymology.* From the Greek *lasios* (= woolly, hairy) and *calyx* in reference to the hairy calyx present in this species.

*Notes.* This species differs from *Eutaxia lasiophylla* in having a hairy calyx, from *E. andocada* and *E. acanthoclada* in the hairy leaves and calyx and from *E. rubricarina* in the yellow keel and the standard lamina without markings. It differs from *E. hirsuta* in having a fine style with the apex that is curved compared with a wider style with hooked apex.

Some specimens of this species held at PERTH have been determined as *Eutaxia* sp. Mt Holland (*B.H. Smith* 543) but this has not been recorded on *FloraBase*.

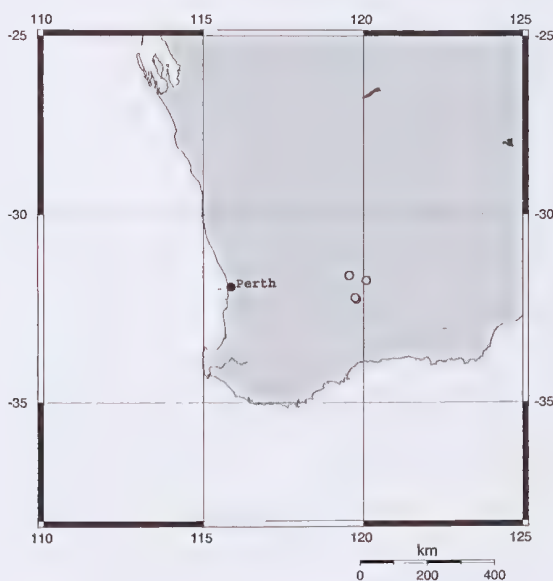


Figure 29. Distribution of *Eutaxia lasiocalyx* in Western Australia.

**2.7. *Eutaxia leptophylla*** Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 26: 268 (1853). *Type citation*: 'Drum. IV. n. 35.' [Western Australia, 1844–1847, *J. Drummond* 4: 35] (*holo*: KW; *iso*: BM550735!, CGE, G!, K (image !), MEL, P!, W).

*Shrub* erect or spreading, densely branched 0.3–1 × 0.5–1 m. *Stems* green with cream or pale red ribs, or red-brown with pale red ribs, without tubercles, glabrous, not spinescent. *Stipules* absent or mid-brown, 0.05–0.1 × 0.05–0.1 mm. *Pulvinus* 0.2–0.3 mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole* 0.05–0.1 mm long; *blade* concolorous grey-green, or discolorous with abaxial surface darker and sometimes reddish purple on the veins, linear, narrowly elliptic, or rarely ovate to obovate, not verrucose, 0.8–2.8 × 0.3–0.6 mm, abaxial surface with obscure or 1 visible rib, blade glabrous; the apex acute or rounded with an uncinat apiculus c. 0.1 mm long. *Flowers* axillary, solitary. *Bracts* absent with flower in the axil of a vegetative leaf, or the flower subtended by a shorter and often broader and thinner textured floral leaf, 1–2.5 × 0.7 mm. *Bracteoles* on the pedicel just below the calyx, red-brown, ovate-lanceolate, 1.1–3 × 0.6–1.2 mm, glabrous, the apex acute and uncinat. *Pedicels* straight, (0.6–)1.1–1.3(–1.8) mm long. *Buds* excluding emergent petals, 2.9–4.5 × 1.5–2 mm, glabrous except for margin of lobes. *Hypanthium* 0.3–0.5 mm long. *Calyx* inconspicuously 5–8-ribbed, green with red markings at base, or at base and centre of lobes, glossy or dull; three abaxial lobes fused at base for 1.1–1.3 mm, symmetrical, 1.8–2.6 × 0.9–1.1 mm; two adaxial lobes fused at base for 1.5–2.4 mm, ovate, straight, 1.1–1.6 × 0.9–1.1 mm, the apex acute. *Standard* claw 1.4–2.5 × 0.35–0.5 mm; lamina base rounded or slightly cordate, with or without auricles; lamina yellow-orange with red veins on back, with a small, pale yellow, triangular eye bordered with bright red markings; lamina broadly elliptic, or broadly ovate, 3.8–5.3 × 5–7 mm; emarginate indent 0.3–0.5 mm. *Wings* claw 1.4–2.1 mm long; lamina adaxial spur straight, 0.3–0.5 × 0.4–0.5 mm; lamina base red, towards the apex yellow-orange, straight, oblong, or slightly obovate, 3.5–5.5 × 1.4–1.7 mm, the apex rounded. *Keel* claw 1.2–2 mm long; lamina red, fading towards base, straight, oblong, or obovate, 3.3–5.5 × 1.8–2.5 mm, glabrous; the apex rounded. *Stamen filaments* 2.7–5.7 × 0.15–0.25 mm; *anthers* yellow, 0.3–0.5 × 0.25–0.3 mm. *Gynoecium* stipe 0.6–0.8 mm long; *ovary* c. 1.5 × 0.5 mm, with evenly distributed, dense, spreading, straight hairs, 0.6–0.7 mm long; *style* curved, 3–3.1 × 0.15 mm, glabrous or base with scattered, spreading, straight hairs c. 0.5 mm long and apical 2/3 glabrous; *stigma* simple. *Fruit* inflated, globose, both margins strongly curved, 3.5–5 × 2.8–3.5 mm, with dense hairs. *Seeds* brown, ellipsoid, c. 1.8 × 1.2 mm; aril white, elliptical, c. 0.8 × 0.4 mm.

*Chromosome number*:  $2n = 16$  voucher Sands 639.1.4, cited as *E. virgata* in Sands (1975).

*Selected specimens*. WESTERN AUSTRALIA: N of Daniell rail crossing, S of Norseman Post Office along the Coolgardie-Esperance Hwy, 30 Oct. 1999, *B. Archer* 1447 (MEL, PERTH); N of Muntadgin, Sep. 1947, *E.T. Bailey* 250 (PERTH); E of Coorow, on Coorow-Wadder Road, 24 July 1977, *C. Chapman* 56046.6 (PERTH); W of Doodlakine, 10 Oct. 2000, *R. Davis* WW 14 – 45 (PERTH); Ridge NW of W Forest Hill on Barokee, Coorow Shire, 23 Aug. 1996, *F. Falconer* 60 (PERTH); Day Street opposite Andersons, N from Kulin, 16 Sep. 2000, *J.P. Francis* 57 (CANB, MEL, NSW, PERTH); Oak Park Shire Reserve at the junction of Oak Park Road and Botherling East Road, NNE of the town of Goomalling, 18 Sep. 1999, *A.G. Guinness et al. s.n.* (PERTH); S of Elsewhere Road on Cunderdin Road, SE of Bonnie Rock Siding, 8 Sep. 1996, *T.R. Lally & B.J. Lepschi* 1202 (AD, CANB, MEL, PERTH); 9 Mile Rock, ENE of Southern Cross, 16 Sep. 1981, *K. Newbey* 8817 (PERTH); N of 3 Mile Rock, 3 Sep. 1963, *V.E. Sands* 639.1.4 (PERTH, SYD); N of Boorabbin, 16 Sep. 1999, *B.H. Smith* 1952 (MEL, NSW, PERTH); Barnong Station, 2 July 1993, *S. Van Vreeswyk* 3637 (PERTH).

*Distribution and habitat.* *Eutaxia leptophylla* is widespread in inland south-western Western Australia from Barnong Station, east of Mullewa to Lort River, west of Esperance (Figure 30). It occurs in open woodland over shrubland, in red sand or brown loamy sand over clay, or red clayey loam on lateritic and granitic substrates, or occasionally in stony, saline areas.

*Flowering period.* July to October.

*Conservation status.* *Eutaxia leptophylla* is widespread with no special requirements for conservation at this time.

*Etymology.* From the Greek *leptos* (= narrow) and *phyllon* (= leaf) in reference to the narrow leaves present in this species.

*Notes.* *Eutaxia leptophylla* is distinguished from all other species of *Eutaxia* that share the features of a curved fine style and simple stigma, in having an uncinat apex of leaves and bracteoles.

Leaves of populations from Wongan Hills (*Gardner* 2722) and (*Gardner & Blackall* 806) have the apex uncinat, but are unusual in being broader and obovate, sometimes with hairy margins or with both leaf surfaces hairy. In addition the keel is yellow orange instead of red. Further study of these populations is required.

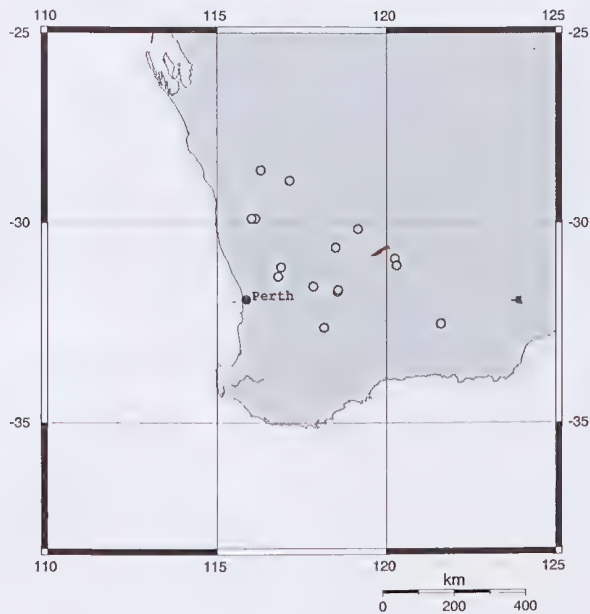


Figure 30. Distribution of *Eutaxia leptophylla* in Western Australia.



**2.8. *Eutaxia microphylla*** (R.Br.) C.H.Wright & Dewar, *Johnson's Gardener's Dictionary*: 1052 (1894). *Sclerothamnus microphyllus* R.Br., in Aiton, *Hortus Kewensis* ed. 2, 3: 16 (Oct.–Nov. 1811). *Type citation*: 'Nat. of the South coast of New Holland. Robert Brown, Esq. Introd. 1803, by Mr. Peter Good.' *Lecto*, here designated: Island 8, South Coast [Thistle Island is anchorage 8 in S. Australia, (Chapman *et al* 2010)], *R. Brown* Bennett No. 4090 (BM 550733!); *isolecto*: K (image!). ?*Paralecto*: Kew Gardens 1807, from seed sent from the South Coast of new Holland [by Peter Good?] (BM 550734!).

Erect, densely branched *shrub* 30–40 cm high. *Stems* green with cream ribs, glabrous, without tubercles, mainly spinescent. *Stipules* absent or cream,  $0.1\text{--}0.2 \times 0.1\text{--}0.15$  mm. *Pulvinus*  $0.2\text{--}0.8$  mm long. *Leaves* spreading, opposite and decussate, internode length shorter than leaf length, *petiole*  $0\text{--}0.2$  mm long; blade concolorous grey-green; narrowly oblong, narrowly ovate or ovate, not tuberculate,  $2.3\text{--}4 \times 0.6\text{--}0.9$  mm, with mid-vein obscure, both surfaces glabrous, margin glabrous or ciliate on new growth; the apex obtuse. *Flowers* axillary, solitary. *Bracts* absent, flowers in the axil of vegetative leaf. *Bracteoles* persistent, on the pedicel just below the calyx, ovate, elliptic,  $1\text{--}1.8 \times 0.8\text{--}1.2$  mm, green or red-brown, glabrous, the apex obtuse. *Pedicels* recurved or straight,  $1.8\text{--}3.5$  mm long. *Buds* excluding emergent petals,  $3.5\text{--}4 \times 1.8\text{--}2$  mm, glabrous, except for hairs on margins of calyx lobes. *Hypanthium*  $0.3\text{--}0.5$  mm long. *Calyx* not ribbed or with 5 faint ribs; mainly green and red on tube, red lobes with red spots on lobe or red markings, dull; total calyx length  $2.7\text{--}4$  mm long, three abaxial lobes imbricate, fused at base for  $1.2\text{--}1.5$  mm, equal length,  $1\text{--}2.2 \times 1\text{--}1.3$  mm; two adaxial lobes valvate, fused at base for  $2\text{--}3.8$  mm, ovate, straight,  $0.5\text{--}2.2 \times 0.9\text{--}1.1$  mm, the apex acute. *Standard* claw  $2\text{--}2.8 \times 0.4\text{--}0.5$  mm; lamina base strongly or slightly cordate, without auricles; lamina yellow-orange, with a small, yellow, ovate eye bordered with deep red markings conspicuous on rear; lamina broadly ovate,  $4.5\text{--}6 \times 6\text{--}7$  mm, emarginate indent  $0.3\text{--}0.4$  mm. *Wings* claw  $1.3\text{--}2.3$  mm long; adaxial spur straight,  $0.3\text{--}0.5 \times 0.3\text{--}0.5$  mm long; lamina yellow-orange, straight, oblong,  $5.5\text{--}8 \times 1.1\text{--}2$  mm, the apex rounded. *Keel* claw  $1.5\text{--}2.3$  mm long; lamina dark red, straight, oblong,  $5.8\text{--}7.5 \times 1.9\text{--}2.5$  mm, glabrous; the apex rounded. *Stamen filaments*  $3.7\text{--}7.8 \times 0.1\text{--}0.15$  mm; *anthers* yellow,  $0.5\text{--}0.6 \times 0.35\text{--}0.45$  mm. *Gynoecium* stipe  $0.7\text{--}1.3$  mm; *ovary*  $1.8\text{--}2.3 \times 0.5\text{--}0.6$  mm, with evenly distributed, dense, spreading, straight hairs, *c.*  $0.4$  mm long; *style* curved,  $2.4\text{--}3.2 \times 0.15$  mm, base glabrous or with scattered, spreading, straight hairs *c.*  $0.4$  mm and remainder glabrous; *stigma* simple. *Fruit* inflated, ellipsoid, both margins strongly curved, *c.*  $5.5 \times 3.2$  mm, outer surface with moderately dense hairs. *Seed* ellipsoid, *c.*  $2.5 \times 1.8$  mm, black without markings; aril ellipsoid, *c.*  $1.3 \times 1$  mm, white.

*Chromosome number*:  $2n = 16$  (vouchers *Sands* 649.1.1, *Sands* 649.1.4, *Sands* 649.2.3; in *Sands* 1975).

*Selected specimens*. NEW SOUTH WALES: Wyalong, 22 Sep. 1906, *J.L. Boorman s.n.* (G, NSW n.v., MEL n.v., P); W of Gubbata on the Naradhan Road, 28 Nov. 1984, *R. Coveny & P. Hind* 12036 (CANB, K, NSW, PERTH); Tamara, Oct. 1917, *J.W. Dwyer s.n.* (G); Koraleigh, S of Balranald, 14 Oct. 1949, *J. Vickery* 10,252 (BM, K). VICTORIA: Murrayville, Oct. 1928, *H.B. Williams s.n.* (G); Western Wimmera, Sep. 1889, *C. French s.n.* (P); Little Desert Area S of Kiata, 11 Oct. 1992, *G.P. Lewis & S. Tan* 2135 (K); W of Kaniva, 15 Sep. 1952, *R. Melville* 881 (K); Werribee, 1863, *F. von Mueller s.n.* (P); Western Wimmera, Sep. 1888, *F. von Mueller s.n.* (P); Western Highway, NW of Stawell, 30 Sep. 1962, *T.B. Muir* 2589 (BM, MEL n.v.); 90 mile desert, *s. dat.*, *C. Walter s.n.* (MEL n.v., P); Chinkapook, 19 Aug. 1918, *A.B. Williamson s.n.* (K, MEL n.v.). SOUTH AUSTRALIA: Kulpara, NW of Adelaide, Northern Yorke Peninsula, 4 Sep. 1966, *B.J. Blaylock* 131 (AD, G); W of Scorpion Spring, Scorpion National Park, S of Pinnaroo, 21 Oct. 1973, *J. Carrick* 3432 (BM, K); Southern Flinders Ranges, Mount Remarkable National Park, at Melrose, 10 Oct. 1973, *K. Czornij*

644 (AD, G); WSW of Kimba, 12 Sep. 1973, *N.N. Donner* 4679 (AD, G); Lower Mount Lofty Range, McLaren Flat, 1 Nov. 1964, *D.N. Kraehenbuehl* 1321 (AD, K); Port Lincoln, *s.dat.*, *F. von Mueller* 18 (P); W of Tuckey, 20 Sep. 1965, *M.E. Phillips* SA/65 477 (CANB, K); N of the Arno Bay turnoff, Eyre Peninsula, 31 Aug. 1964, *V.E. Sands* 649.1.1 (PERTH, SYD); Eyre Peninsula, 31 Aug. 1964, *V.E. Sands* 649.1.4 (PERTH, SYD); Port Lincoln, St Andrews Tce, 1 Sep. 1964, *V.E. Sands* 649.2.3 (PERTH); N of Port Lincoln, 13 Sep. 1970, *M.D. Tindale* 488 (AD, NSW, K); W of Cape Donington, Spalding Cove, 8 Oct. 1958, *P.G. Wilson* 313 (AD, K). TASMANIA: North east: Flinders Island. Specimens not viewed by first author, however, Flora of Tasmania describes ovate leaves and pungent branchlets for *E. microphylla*.

*Distribution and habitat.* *Eutaxia microphylla* occurs in Victoria and New South Wales west of the Great Dividing Range, in north east Tasmania and in southern South Australia (Figure 31). It has been collected from heathland, shrubland and open forest and is commonly found amongst *Acacia*, *Eucalyptus* and *Eremophila*. The recorded habitat is red-brown sand.

*Flowering period.* July to October.

*Conservation status.* Conservation requirements unknown. This species does not occur in Western Australia but from old collections appears to be abundant in South Australia.

*Etymology.* From the Greek *micro-* (= small) and *phyllon* (= leaf) in reference to the small leaves present in this species.

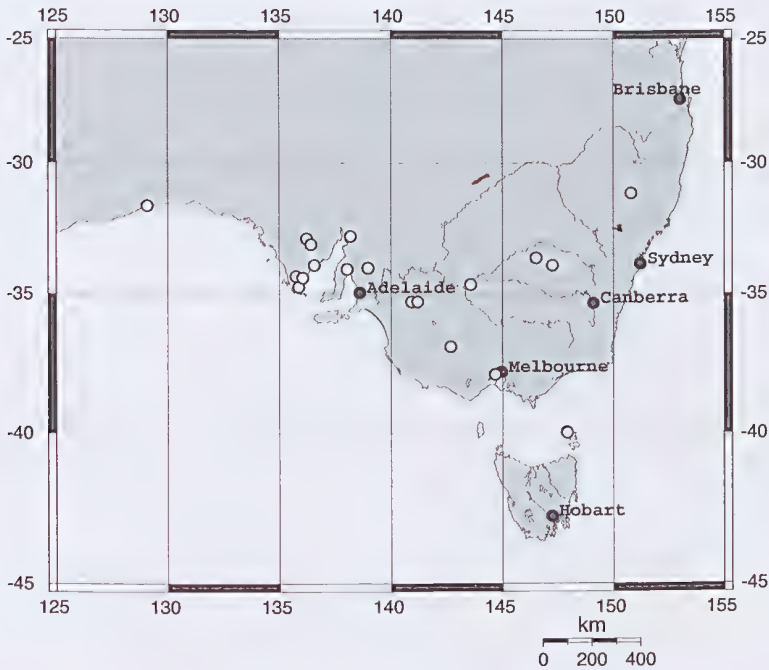


Figure 31. Distribution of *Eutaxia microphylla* in southern Australia.

*Notes.* *Eutaxia microphylla* can be distinguished from *E. empetrifolia* and *E. diffusa* by its leaves being ovate to oblong with an obtuse apex and more truncate base, rather than being obovate with a subacute to acute apex and more tapered base. *Eutaxia microphylla* displays some resemblance to *E. acanthoclada* and *E. parvifolia*; however, it can be distinguished from *E. parvifolia* by the filiform, elongate style and simple stigma as opposed to the thick, hooked style and capitate stigma of that species. *Eutaxia acanthoclada* can be differentiated by its alternate, rather than having opposite leaves, and its all-yellow flower petals rather than being red-keeled. Further research may show *E. nanophylla* to be a subspecies of *E. microphylla* as they vary only in the former having smaller leaves, hairs always present on the leaf margins and branchlets never pungent, compared with marginal leaf hairs occasionally present and branchlets frequently pungent in *E. microphylla*.

There are two unusual Geneva herbarium specimens. The first Eichler 19412 from Elliston, South Australia, resembles *E. microphylla* but has broader, grey leaves and broader calyx lobes. It requires further collection to establish if it represents a new species.

The second, *F.M. Reader s.n.* from Dimboolah, closely resembles *E. microphylla*, but it has moderately dense hairs on the outer calyx compared with being glabrous.

The BM specimen has been chosen as the lectotype as it is annotated as a Brown collection from the south coast of Australia, is a good quality specimen and matches the species description. The first author has viewed a Kew photo of a duplicate of the Brown collection, Bennett no. 4090, that is a probable isoelectotype, collected from 'Ins[ula no.] 8'.

**2.9. *Eutaxia nanophylla*** Chappill & C.F. Wilkins, *Nuytsia* 17: 478–840 (2007). *Type:* north-west of Lake Cronin, Western Australia [precise locality withheld for conservation reasons], 13 September 1981, *K.R. Newbey* 8800 (*holo:* PERTH 00627445!; *iso:* CANB).

*Shrub* spreading or rounded, sparsely branched, 0.15–0.35 × 0.3–0.55 m. *Stems* red-brown, faintly ribbed, without tubercles, young stems with scattered to medium density, spreading, straight hairs 0.15–0.2 mm long, becoming glabrous, not spinescent. *Stipules* absent. *Pulvinus* 0.2–3 mm long. *Leaves* appressed or spreading, opposite and decussate, or alternate, internode length shorter than leaf length; *petiole* 0.05–0.1 mm long; *blade* concolourous, green or grey-green, without markings; ovate, 0.5–2.7 × 0.5–0.8 mm; abaxial surface with veins indistinct or one, slightly verrucose; mainly both surfaces glabrous, or scattered hairs on adaxial, or abaxial or both surfaces, margins ciliate; the apex obtuse, straight. *Flowers* axillary, solitary. *Bracts* absent, flowers in axil of vegetative leaf. *Bracteoles* on the pedicel just below the calyx, red-green, lanceolate, 1.3–1.7 × 0.5–1 mm, glabrous, or with scattered, spreading, straight hairs *c.* 0.1 mm long on margin. *Pedicels* straight, 0.8–1.3 mm long. *Buds* excluding emergent petals, 2.5–4 × 1.5–1.8 mm, glabrous except for margins of lobes. *Hypanthium* 0.35–0.6 mm long. *Calyx* faintly 6-ribbed, red-brown or green with dark red markings, dull; three abaxial lobes fused at base for 0.9–1.4 mm, 1.4–2.4 × 0.65–1 mm, symmetrical; two adaxial lobes fused at base for 1.4–1.8 mm, 0.95–1.3 × 0.6–0.9 mm, ovate, straight, the apex acute. *Standard* claw 1.2–1.6 × 0.3–0.5 mm; lamina base truncate or slightly cordate, not or only slightly auriculate; lamina yellow-orange with a pale yellow, triangular eye, bordered with bright red veins; lamina broadly ovate, 3.3–4 × 4.4–6.1 mm, emarginate indent *c.* 0.3 mm long. *Wings* claw 1.2–1.5 mm long; adaxial spur *c.* 0.4 × 0.5 mm, straight; lamina yellow, straight, oblong, or slightly obovate, 3.1–3.5 × 1.2–1.8 mm, the apex rounded. *Keel* claw 1.1–1.5 mm long; lamina red, straight, oblong, or rounded on abaxial margin, 3–3.7 × 1.5–2.4 mm, glabrous; the apex rounded. *Stamen filaments*, 1.8–4.7 × 0.25–0.3 mm; *anthers* yellow, 0.3–0.5 × 0.25–0.35 mm. *Gynoecium stipe* 0.5–0.7 mm long; *ovary* 1.5–1.9 × 0.5–0.8 mm, with evenly distributed, dense, spreading, straight hairs, 0.4–0.6 mm long;



style curved,  $2\text{--}2.7 \times 0.1\text{--}0.15$  mm, base with scattered, spreading, straight hairs c. 0.15, remainder glabrous; stigma simple. Fruit and seed not seen.

*Chromosome number.* Unknown.

*Selected specimens.* WESTERNAUSTRALIA: [localities withheld] 11 Sep. 1947, *N.T. Burbidge* 2422 (CANB); 2 Nov. 1998, *A.M. Coates* 4458 (NEW, NSW, PERTH); 26 Oct. 1993, *V. Crowley* DKN 321 (PERTH); 1 Oct. 1928, *C.A. Gardner* 2088 (K, PERTH); 3 Oct. 1979, *K.R. Newbey* 6202 (PERTH); 7 Oct. 1981, *K.R. Newbey* 9240 (PERTH); 25 June 1990, *H. Pringle* 2846 (PERTH); 10 Sep. 1982, *P.S. Short* 1676 (AD, CANB, HO, MEL, NSW, PERTH).

*Distribution and habitat.* *Eutaxia nanophylla* occurs in Western Australia from Riverina Station to the northern Stirling Ranges, with a westernmost collection from Duranillin (Figure 32). It occurs in woodland, shrubland or rarely open hermland, on sand over clay, stony, clay loam, or red clay.

*Flowering period.* September to November.

*Conservation status.* This species is known from seven localities; however, its presence at early collection sites has not been recently confirmed. Listed as Priority Three under DEC Conservation Codes for Western Australia (Smith 2010).

*Etymology.* From the Greek *nanos* (= dwarf) and *phyllon* (= leaves) in reference to its very small leaves.

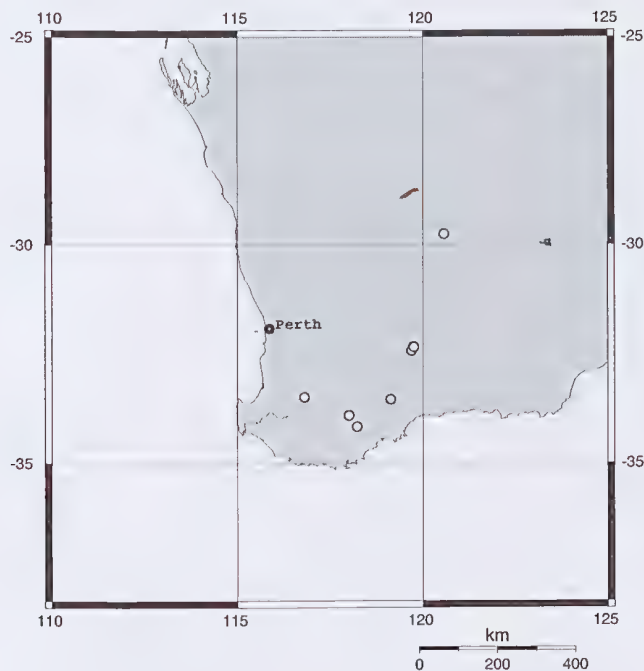


Figure 32. Distribution of *Eutaxia nanophylla* in Western Australia.

*Notes.* This species may be synonymous with *E. microphylla*, but differs in the stem apex not being spinous, stems hairy not glabrous and leaf margins always ciliate compared with only sometimes. It differs from *E. lasiocalyx* in having a glabrous calyx and red compared with a yellow-orange keel.

Specimens of this species held at PERTH have been determined as *Eutaxia* sp. Lake Cronin (K.R. Newbey 8800) but this has name not been recorded on FloraBase.

**2.10. *Eutaxia rubricarina*** Chappill & C.F. Wilkins, *Nuytsia* 17: 480–482 (2007). *Type:* near Kokeby, Western Australia [precise locality withheld for conservation reasons], 16 August 2002, *T. Watson* 225 (*holo:* PERTH 06358616!; *iso:* CANB, MEL).

*Shrub* erect, spreading or prostrate, straggling, sparsely branched, 0.02–0.5 × 0.5 m. *Stems* brown or green with cream ribs, without tubercles, with dense, spreading, curled hairs *c.* 0.2 mm long, not spinescent. *Stipules* absent. *Pulvinus* *c.* 0.4 mm long. *Leaves* spreading, alternate or opposite, internode length shorter than leaf length, *petiole* 0.05–0.1 mm long; blade concolourous, grey-green or red-green, or discolourous with abaxial surface with purple markings; ovate to linear, 0.5–3.3 × 0.4–1.3 mm, abaxial surface distinctly 1- or 3-ribbed and verrucose, margin and both surfaces with scattered, spreading, straight hairs *c.* 0.15 mm long, the apex obtuse and straight. *Flowers* axillary, solitary. *Bracts* absent, flowers in axil of vegetative leaf. *Bracteoles* persistent just below the calyx, grey-green or red-green, ovate-lanceolate, 1.3–2.3 × 0.7–1 mm, both surfaces and margin with scattered, spreading, straight hairs *c.* 0.15 mm long. *Pedicels* straight, 0.4–1.1 mm long. *Buds* excluding emergent petals 2.5–3.8 × 1.7–2 mm, outer surface and margin of calyx lobes with scattered to medium density, spreading, straight or wavy, hairs 0.15–0.3 mm long. *Hypanthium* *c.* 0.5 mm long. *Calyx* not ribbed, green with dark red blotches and stripes, with or without red spots at junction of lobes, dull; total calyx length 4–6 mm long, three abaxial lobes fused at base for 1.3–1.4 mm, middle abaxial lobe 1.9–2.4 × 1.3–1.4 mm, lateral lobes 2.1–2.3 × 1.1–1.4 mm; two adaxial lobes fused at base for 1.9–3 mm, ovate, straight, 0.5–1.3 × 0.5–1.1 mm, the apex acute. *Standard* claw 1.5–2.1 × 0.35–0.7 mm; lamina base truncate or cordate, not auriculate; lamina yellow-orange, with a small, paler yellow, ovate to triangular eye bordered with deep red vein markings, broadly ovate, 4.5–5.6 × 7–7.8 mm, emarginate indent 0.5–0.7 mm. *Wings* claw 1.7–2 mm long; adaxial spur *c.* 0.6 × 0.5 mm, straight; lamina yellow-orange, straight, oblong, to slightly obovate, 4.9–5.9 × 1.8–2.1 mm, the apex rounded. *Keel* claw 1.3–1.8 mm long; lamina dark red, obovate, straight, 4.8–5.1 × 2.8–3 mm, glabrous; the apex rounded. *Stamen filaments* 3.5–5.2 × 0.15–0.3 mm; *anthers* cream to grey-brown, 0.5 × 0.35–0.4 mm. *Gynoecium* stipe 0.7–1 mm; *ovary* 1.2–1.7 × 0.7 mm, with evenly distributed dense, spreading, straight hairs, 0.7–1 mm long; *style* curved, 3.3–4.3 × 0.15–0.2 mm, base with scattered, spreading, straight hairs 0.2 mm long, remainder glabrous; *stigma* simple. *Fruit* and *seed* not seen.

*Selected specimens.* WESTERN AUSTRALIA: [localities withheld] 5 Oct. 1933, *W.E. Blackall* 3276 (PERTH); 7 Oct. 1986, *T. Macfarlane* 1691 (PERTH); 23 Aug. 1979, *K.R. Newbey* 5802 (PERTH); 18 Sep. 2000, *M. Ochman* & *D. Lynch* 6 (BELY, PERTH); 31 July 1988, *B.H. Smith* 1056 (BRI, CANB, MEL); 3 Oct. 2002, *T. Watson* & *P. Clynk* 370 (BELY, PERTH).

*Distribution and habitat.* *Eutaxia rubricarina* is known from the south-west of Western Australia from Manmanning to Quairading and east from Yellowdine to Lake Cronin (Figure 33). It grows in open woodland on grey, gravelly sand, red loam or pinkish-white, sandy clay with gravel.

*Flowering period.* July to October.

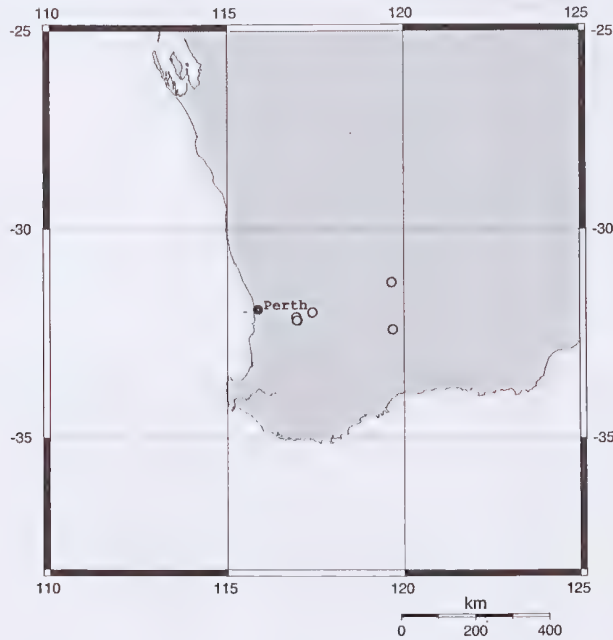


Figure 33. Distribution of *Eutaxia rubricarina* in Western Australia.

**Conservation status.** Listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2010) as it is only known from a few locations.

**Etymology.** From the Latin *rubro-* (= red-) and *carina* (= keel) in reference to the red keel present in this species.

**Notes.** *Eutaxia rubricarina* is characterised by its hairy calyx and verrucose leaves that are ovate and hairy on the adaxial surface. It is distinguished from *E. lasiocalyx* by having a red rather than a yellow keel.

Some specimens of this species held at PERTH have been determined as *Eutaxia* sp. Kokeby (T. Watson & P. Clynk 370) but this name has not been recorded on *FloraBase*.

### Excluded names

*Eutaxia divaricata* Turcz. = *Dillwynia divaricata* (Turcz.) Benth.

*Eutaxia patula* F. Muell. ex Sond. = *Dillwynia uncinata* (Turcz.) J.Black

*Eutaxia punctata* Turcz. = *Gastrolobium punctatum* (Turcz.) G.Chandler & Crisp

*Eutaxia pungens* Sweet = *Dillwynia pungens* (Sweet)Lodd.



*Eutaxia reticulata* Meisn. in Lehm. = *Gastrolobium reticulatum* (Meisn.) Benth.

*Eutaxia sparsifolia* F. Muell. = *Dillwynia uncinata* (Turcz.) J.Black

*Eutaxia strangeana* Turcz. = *Dillwynia retorta* (Wendl.) Druce

*Eutaxia uncinata* Turcz. = *Dillwynia uncinata* (Turcz.) J.Black

### Acknowledgements

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Index of scientific names

*Bold italics* are currently accepted taxa in *Eutaxia*.

Taxon Name	Taxon Number
<i>Eutaxia</i> R.Br. = <i>Eutaxia</i> R.Br. sect. <i>Eutaxia</i>	
<i>Sclerothamnus</i> R.Br. = <i>Eutaxia</i> R.Br. sect. <i>Sclerothamnus</i>	
<i>Dillwynia incerta</i> Domin = <i>E. myrtifolia</i>	
<i>Dillwynia myrtifolia</i> Sm. = <i>E. myrtifolia</i>	
<i>Dillwynia obovata</i> Labill.= <i>E. myrtifolia</i>	
<i>Eutaxia acanthoclada</i> G.R.Hend. & Chappill	2.1
<i>Eutaxia actinophylla</i> Chappill & C.F.Wilkins	2.2

<i>Eutaxia andocada</i> Chappill & C.F.Wilkins	2.3
<i>Eutaxia alternifolia</i> Chappill ms = <i>E. andocada</i>	
<i>Eutaxia baxteri</i> Knowles & Westc. = <i>E myrtifolia</i>	
<i>Eutaxia cuneata</i> Meisn.	1.1
<i>Eutaxia densifolia</i> Turcz. = <i>E. parvifolia</i> Benth.	
<i>Eutaxia diffusa</i> F.Muell.	2.4
<i>Eutaxia dillwynioides</i> Meisn. = <i>E. parvifolia</i>	
<i>Eutaxia divaricata</i> Turcz. = <i>Dillwynia divaricata</i> (Turcz.) Benth.	
<i>Eutaxia empetrifolia</i> Schldtl.	2.5
<i>Eutaxia epacridoides</i> Meisn.	1.2
<i>Eutaxia epacridoides</i> Meisn. subsp. <i>sparsifolia</i> G.R.Henderson ms = <i>E. exilis</i>	
<i>Eutaxia ericoides</i> Meisn. var. <i>ericoides</i> = <i>E. virgata</i>	
<i>Eutaxia ericoides</i> var. <i>filicaulis</i> Meisn. = <i>E. virgata</i>	
<i>Eutaxia exilis</i> C.F.Wilkins & G.R.Hend.	1.3
<i>Eutaxia hirsuta</i> C.F.Wilkins & Chappill	1.4
<i>Eutaxia inuncta</i> C.F.Wilkins & Chappill	1.5
<i>Eutaxia lasiocalyx</i> Chappill & C.F.Wilkins	2.6
<i>Eutaxia lasiophylla</i> G.R.Hend.	1.6
<i>Eutaxia leptophylla</i> Turcz.	2.7
<i>Eutaxia lutea</i> Chappill & G.R.Hend.	1.7
<i>Eutaxia major</i> (Benth.) C.F.Wilkins & Chappill	1.8
<i>Eutaxia microphylla</i> (R.Br.) C.H.Wright & Dewar	2.8
<i>Eutaxia microphylla</i> (R.Br.) C.H.Wright & Dewar var. <i>microphylla</i> = <i>E. microphylla</i>	
<i>Eutaxia microphylla</i> (R.Br.) C.H.Wright & Dewar var. <i>diffusa</i> (F.Muell.) Court = <i>E. diffusa</i>	
<i>Eutaxia myrtifolia</i> (Sm.) R.Br	1.9
<i>Eutaxia myrtifolia</i> var. <i>angustifolia</i> Meisn. = <i>E. myrtifolia</i>	
<i>Eutaxia nanophylla</i> Chappill & C.F.Wilkins	2.9
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend.	1.10
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>neurocalyx</i>	1.10a
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>nacta</i> C.F.Wilkins	10b
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>papillosa</i> C.F.Wilkins	1.10c
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>hirsuta</i> ms = <i>E. hirsuta</i>	
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>major</i> ms = <i>E. inuncta</i>	
<i>Eutaxia neurocalyx</i> (Turcz.) Chappill & G.R.Hend. subsp. <i>leptophylla</i> ms = <i>E. major</i>	



*Eutaxia obovata* (Labill.) C.A.Gardner = *E. myrtifolia*

*Eutaxia obovata* Turcz. = *E. parvifolia*

*Eutaxia parvifolia* Benth.

1.11

*Eutaxia patula* D.Dietr. = *Dillwynia patula* F. Muell.

*Eutaxia punctata* Turcz. = *Gastrolobium punctatum* (Turcz.) G.Chandler & Crisp.

*Eutaxia pungens* Sweet = *Dillwynia pungens* (Sweet) Mackay ex Lodd.

*Eutaxia reticulata* Meisn. = *Gastrolobium reticulatum* (Meisn.) Benth.

*Eutaxia rubricarina* Chappill & C.F.Wilkins

2.10

*Eutaxia* sp. Hatter Hill (K.R. Newbey 6532) = *E. acanthoclada*

*Eutaxia* sp. Kokeby (T. Watson & P. Clynk 370) = *E. rubricarina*

*Eutaxia* sp. Lake Cronin (K.R. Newbey 8800) = *E. nanophylla*

*Eutaxia* sp. Mt Holland (B.H. Smith 543) = *E. lasiocalyx*

*Eutaxia* sp. Norseman (Archer 1387) = *E. actinophylla*

*Eutaxia* sp. Peak Eleanora (M.A. Burgman 3862) = *E. andocada*

*Eutaxia sparsifolia* F.Muell. = *Dillwynia uncinata* (Turcz.) J.M.Black

*Eutaxia strangeana* Turcz. = *Dillwynia retorta*?

*Eutaxia uncinata* Turcz. = *Dillwynia uncinata* (Turcz.) J.M.Black

*Eutaxia verticillata* Chappill & C.F.Wilkins ms = *E. actinophylla*

*Eutaxia virgata* Benth.

1.12

*Eutaxia virgata* var. *diffusa* Regel = *E. diffusa*?

*Pultenaea neurocalyx* Turcz. = *E. neurocalyx*

*Pultenaea neurocalyx* Turcz. var. *major* Benth. = *E. inuncta*

*Sclerothamnus microphyllus* R.Br. = *E. microphylla* (R.Br.) C.H.Wright & Dewar



## Two new, glaucous-leaved species of *Isopogon* (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia

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### Abstract

Hislop, M. & Rye, B.L. Two new, glaucous-leaved species of *Isopogon* (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia. *Nuytsia* 20: 169–181 (2010). Two new species and two new subspecies with simple, flat, glaucous leaves are described: *Isopogon panduratus* Hislop & Rye, *I. panduratus* subsp. *palustris* Hislop & Rye, *I. pruinus* Hislop & Rye and *I. pruinus* subsp. *glabellus* Hislop & Rye. Their distributions are mapped and the first three are illustrated. The four new taxa belong in a species group that includes *Isopogon axillaris* R.Br. and *I. buxifolius* R.Br. *s. lat.* *Isopogon panduratus* subsp. *palustris* has conservation priority.

### Introduction

*Isopogon* R.Br. ex J. Knight is a moderately large genus belonging to the subfamily Proteoideae and occurring in southern mainland Australia and on islands in the Bass Strait. The genus was until recently included in the tribe Conospermeae, but as a result of a comprehensive molecular analysis of the family, utilizing published and unpublished DNA sequence data from several genomic regions, it has been transferred to a newly described tribe, Leucadendreae (Weston & Barker 2006).

Foreman's treatment (1995) of *Isopogon* in Volume 16 of *Flora of Australia* was curtailed by ill health caused in part by an allergic reaction to contact with the two proteaceous genera, *Isopogon* and *Petrophile*, that were then the subject of his research (Alex George, pers. com.). It is probable that he would have recognised additional species had he been able to complete his revision of the genus prior to publication of the flora treatment. As it was however he retained the pre-existing, taxonomic status quo in the most complex group of western species, those with simple, thick, flat leaves allied to *Isopogon buxifolius*. This did not adequately reflect the group's diversity and led him to circumscribe some species, especially *I. buxifolius* very broadly, while at the same time leaving numerous specimens largely unresolved. Foreman was clearly unsure what to do with the glaucous-leaved specimens now attributable to the two species described below. He annotated these in a variety of ways, sometimes identifying them as named species such as *I. axillaris* or *I. polycephalus*, at other times using informal names or indicating affinities only, e.g. '*Isopogon* sp. 2', '*I. attenuatus* complex' or '*I. polycephalus* variant'. Bentham (1870) included the simple, flat-leaved species in section *Hypsanthus* (Endl.) Benth, however it is clear that this subgeneric grouping, at least as applied by Bentham, is an artificial one.



It was not long after the flora treatment of *Isopogon* appeared that its limitations became apparent. Even before its publication, the name *Isopogon* sp. Watheroo (D. Foreman 477) had been added to the Census of Western Australian Plants by ecologist E.A. (Ted) Griffin for a species with glaucous leaves that he had observed while working on vegetation surveys of the Geraldton sandplains. In its original application that name was restricted to populations occurring north of Perth and included collections of a second taxon that was later segregated as *I.* sp. Badgingarra (A.S. George 14200). These northern taxa are described here as the two subspecies of *Isopogon panduratus* Hislop & Rye. The concept of *I.* sp. Watheroo was later expanded to include plants with a generally similar morphology from the central and south-eastern wheatbelt which are described below as *I. pruinusus* Hislop & Rye.

Apart from the taxa treated in this paper, an additional five informal names have been allocated to new Western Australian members of the genus, four of which apply to other species from the *Isopogon buxifolius* group. These will be described in a separate paper.

## Methods

This study was based on an examination of collections housed at PERTH. All measurements were obtained from dried specimens. Although the leaves of members of the simple, flat-leaved group are often distinctly narrowed towards the base, there is no corresponding change in tissue type that would indicate the presence of a petiole. They are therefore considered here to be essentially sessile, and the leaf length was therefore measured from the apex to the point of attachment. The inflorescence-subtending leaves grade into involucre bracts across several very short, spirally-arranged nodes. There are several whorls of involucre bracts and the outer was considered to begin with the first bract lacking any terminal herbaceous appendage (i.e. vestigial leaf lamina). Measurements were taken, and observations made, of the outer and innermost whorls. The tepal limb was measured from the point of insertion of the filament to the tepal apex, excluding the hair tuft. Most species in the simple, flat-leaved group (including the two described here) have the distinctively shaped pollen presenter which is characteristic of the genus. This comprises four, more or less, well-defined zones. The style expands gradually into the usually, narrowly obovoid, basal portion of the pollen presenter, which terminates abruptly in a narrow constriction. Above the constriction is a short bulge, and above that a tapering, usually longitudinally grooved and viscid, portion referred to here as the receptor. It is to the receptor that most of the pollen adheres in newly opened flowers. At the apex of the receptor is the rather dilated stigma. Four separate measurements of the pollen presenter were included in the descriptions below: the length of basal portion (from the point at which the style expands to the base of the constriction), the length of the receptor (from the top of the bulge to the stigma inclusive), the length of the pollen presenter in its entirety and the width at its widest point (which is either at the top of the basal portion or the bulge). The distribution maps were compiled using DIVA-GIS Version 5.2.0.2 and based on PERTH specimen data.

## Taxonomy

***Isopogon panduratus* Hislop & Rye, *sp. nov.***

*Isopogon axillari* affinis sed inflorescentiis grandioribus floribus numerosis, pollinis praebitoris longioribus, pilis tepalorum longioribus densioribus differt.

*Typus*: Garabaldi Willis Rd, [Tathra National Park], 1.6 km S of Eneabba–Carnamah Rd, [E of Eneabba], Western Australia, 16 July 2000, *M. Hislop* 2041 (*holo*: PERTH 05815266 (sheet 1), PERTH 05815274 (sheet 2); *iso*: CANB, MEL).

Robust, spreading *shrubs* to c. 2.0 m high and 1.5 m wide, with a fire-sensitive rootstock. Young *branchlets* distinctly ribbed to almost smooth, pale brown to reddish-brown, the older wood grey, with a sparse to moderately dense indumentum of soft, variously orientated, straight or  $\pm$  curled, tubercle-based hairs often of mixed lengths, the longest to c. 1.2 mm long. *Leaves* simple, entire, usually glaucous at least when fresh, variously orientated between patent and steeply antrorse; apex mucronate; lamina narrowly obovate in the upper 2/3–3/4 of its length, above a long attenuate, petiole-like portion which gradually expands again towards the base, 35–125(–150) mm long, 3–19 mm wide,  $\pm$  flat to shallowly or deeply concave adaxially, straight to prominently incurved along the longitudinal axis, thick, with indistinct venation, apart sometimes from the midrib,  $\pm$  hairy when young with a similar tubercle-based indumentum to that of the branchlets, but soon glabrescent, leaving the surfaces finely tuberculate. *Inflorescence* globose or depressed-globose, 18–30 mm diam., (30–)40–70(–105)-flowered, terminal or axillary, sessile, subtended by, and the basal portion partially obscured by, the expanded leaf bases, solitary or several grouped together in clusters. *Involucral bracts* in 3–5 whorls; the outer bracts broadly ovate, ovate or obovate, 6.8–12.5 mm long, 3.3–6.7 mm wide, abaxial surface appressed-hairy throughout or at least in upper half, whitish if densely hairy but otherwise often purple-tinted, the colour fading to brown in old dried specimens, adaxial surface with a zone of appressed hairs towards the apex, otherwise glabrous, apex mucronate or obtuse, margins ciliate; the inner bracts narrowly obovate or narrowly panduriform, 9.1–13.5 mm long, 1.3–2.3 mm wide, abaxial surface densely appressed-hairy in upper 1/2–2/3, either glabrous below or with a few coarse crinkled hairs, adaxial surface with a zone of appressed hairs towards the apex, glabrous below, apex acute, margins ciliate, usually throughout, but sometimes only in the upper half. *Cone scales* very narrowly panduriform, usually wider towards the apex, 9.4–13.9 mm long, 0.7–1.3 mm wide, abaxial surface with a strongly dimorphic indumentum, densely appressed-hairy on the expanded upper portion, much less hairy to  $\pm$  glabrous on the narrower, central portion, with a zone of coarser, more spreading, crinkled hairs towards the base, adaxial surface densely appressed-hairy on the upper portion,  $\pm$  glabrous, or with just a few hairs below, apex acute, margins usually ciliate throughout with straight, fine hairs above and crinkled, coarse ones below. *Perianth tube* slightly expanded about the ovary, otherwise filiform, glabrous, pale pink, 18–27 mm long; *lobes* pale pink, 4.4–6.1 mm long, the limb slightly darker, 2.3–3.1 mm long, with a tuft of straight, white hairs at the apex, 0.5–1.1 mm long, from which a row of marginal hairs usually extend to a point at least a third the way down the limb. *Anthers* 1.9–2.5 mm long. *Style* glabrous, 15–25 mm long. *Pollen presenter* (3.2–)3.4–4.7 mm long, 0.35–0.50 mm wide; the base narrowly obovoid, 1.0–2.1 mm long, densely papillate with retrorse white or yellow papillae, 0.08–0.20 mm long; the constriction usually prominent, papillate or  $\pm$  glabrous; the bulge prominent with the same indumentum as the base or occasionally almost glabrous; the receptor 1.7–2.2 mm, tapering gradually towards the stigma, viscid, glabrous throughout or with some papillae towards the base. *Stigma* prominently dilated, cupular. *Cones* globose or depressed-globose, 9–16 mm long, 10–18 mm wide. *Nuts* ovoid, 3.2–3.7 mm long, 1.3–1.6 mm wide, with long, spreading hairs throughout, the longest of these (4–5 mm long) at the base, becoming progressively shorter towards the apex.

*Etymology*. The epithet is derived from the Latin *pandura* (a musical instrument similar to a fiddle), in reference to the shape of the inner involucral bracts, cone scales and the very broad-based leaves subtending the inflorescences.

*Affinities.* *Isopogon panduratus* is unlikely to be confused with any other species of *Isopogon* in the northern sand-plains. It is most similar to *I. pruinus* Hislop & Rye (described below) and *I. axillaris*, which occur respectively, well to the south-east and south of the range of *I. panduratus*.

*Isopogon pruinus* can be distinguished by its smaller inflorescences with fewer, shorter flowers and generally shorter cone scales with a monomorphic or weakly dimorphic indumentum. Additionally the perianth limb of *I. pruinus* is glabrous below the apical tuft whereas in *I. panduratus* sparse hairs extend along the margins of the limb below the tuft for at least a third of its length (in all, or at least some flowers). There is also a foliar difference. Although both species usually have conspicuously glaucous leaves when live, once dried this character becomes much less apparent in *I. panduratus* with the excrescence often observable only under magnification. By contrast in *I. pruinus* the prominent white excrescence apparently persists indefinitely, unless the leaves have been physically abraded.

*Isopogon axillaris* from the wet, far south-west corner of Western Australia is readily separated by its non-glaucous leaves which are unexpanded towards the base, and in having a fewer-flowered inflorescence (to c. 20-flowered) and tepals with longer, more widely distributed hairs.

*Notes.* Two subspecies are recognised. They differ mainly in foliar morphology and ecological preference.

**Key to subspecies of *Isopogon panduratus***

- 1. Mature leaves 7–19 mm wide, flat or shallowly concave; outer involucre bracts hairy for most (2/3–3/4) of their length, with marginal cilia mostly in more than one layer, the longest ones (0.4–)0.5–0.7 mm long (uplands mostly from NE of Eneabba to S of Watheroo).....subsp. **panduratus**
- 1: Mature leaves 3–8 mm wide, deeply concave; outer involucre bracts glabrous in basal half, with marginal cilia mostly in a single layer, 0.3–0.5 mm long (seasonal wetlands on coastal plain from NE of Cervantes to the Cooljarloo area) .....subsp. **palustris**

**a. *Isopogon panduratus* Hislop & Rye subsp. *panduratus***

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

Robust, spreading *shrubs* usually 0.5–1.5 m high, with one record of 1.9m, commonly 1–1.5 mm wide but up to 3 m. *Branchlets* usually with a dense indumentum directly below each flower head; hairs 0.5–1.2 mm long. Mature *leaves* flat or shallowly concave, 50–150 mm long, 7–19 mm wide. *Outer involucre bracts* usually with a dense indumentum of white antrorse-appressed hairs on abaxial surface, with hairs extending over the upper two thirds to three quarters of the bract length, and with appressed hairs over part of adaxial surface, margins densely hairy with more than one series of cilia, the longest ones (0.4–)0.5–0.7 mm long. (Figure 1 A–K)

*Other specimens examined:* WESTERNAUSTRALIA: 10 miles [c. 16 km] W of Winchester on Eneabba Rd, W of Carnamah, 24 Aug. 1965, *A.C. Beaglehole* 12096 (NSW, PERTH); Location 10903, First North Rd, 5 km from Eneabba–Three Springs Rd, 14 Dec. 2002, *J. Borger* BB 94 (PERTH); Turkey Flat Rd, W side, N of Antonio Rd turnoff [SW of] Three Springs, May 2005, *J. Borger* TF 1 (PERTH); Watheroo West Rd, Coomallo, 31 May 1972, *S.J.J. Davies s.n.* (PERTH); 20 miles [c. 32 km] W of



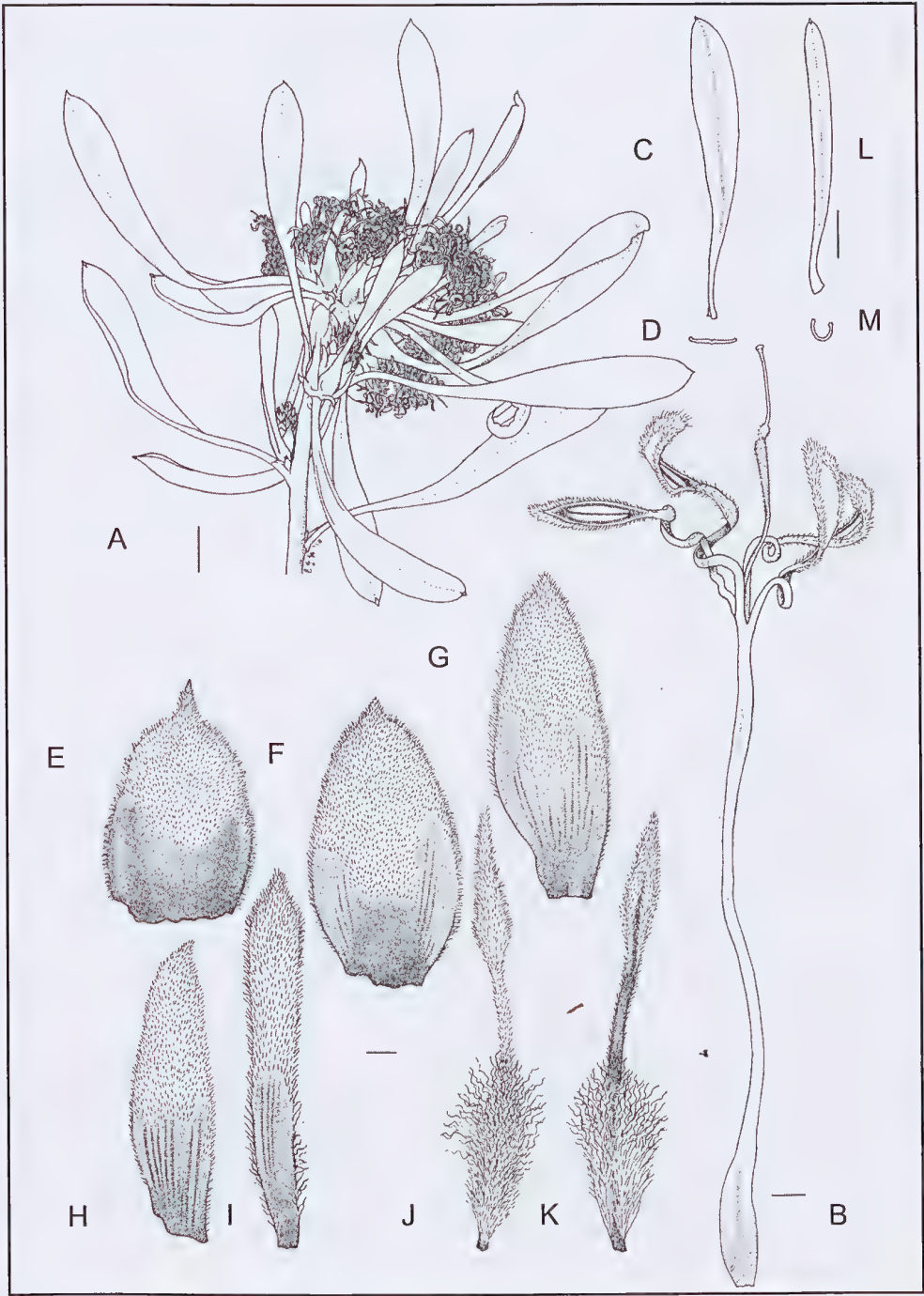


Figure 1. A–K. *Isopogon panduratus* subsp. *panduratus*. A – flowering branchlet; B – flower; C – leaf, abaxial surface; D – leaf section; E – outer involucre bract, abaxial surface; F–H – intermediate involucre bracts, abaxial surface; I – inner involucre bract, abaxial surface; J – cone scale, abaxial surface; K – cone scale, adaxial surface; L. *M. Isopogon panduratus* subsp. *palustris*. L – leaf, abaxial surface; M – leaf section. Scale bars: A, C, D, L & M = 10 mm; B, E, F, G, H, I, J & K = 1 mm. Drawn by Ellen Hickman from *M. Hislop* 2041 (A–K), *M. Hislop* 3797 (L, M).

Three Springs, 24 Aug. 1972, *H. Demarz* 3905 (PERTH); Marchagee Track c. 27 km E of Brand Highway, 1 Sep. 1984, *D.B. Foreman* 477 (CANB, K, NSW, PERTH); 40–45 km SW of Three Springs on Eneabba Rd, 4 Sep. 1984, *D.B. Foreman* 543 (CANB, PERTH); Hill River (near Jurien), June 1943, *C.A. Gardner s.n.* (PERTH); W from Winchester, July 1965, *C.A. Gardner s.n.* (PERTH); Alexander Morrison National Park, 7 Sep. 1979, *E.A. Griffin* 2195 (MEL, PERTH); Hill off Brand Highway, 7 km S of Jurien turnoff, 25 July 1980, *E.A. Griffin* 2762 (PERTH); SE corner of Reserve no. 31030, S of Eneabba, 5 Aug. 1981, *E.A. Griffin* 3154 (PERTH); Hi Vallee property, Warradarge, W boundary track of main bush block, c. 250 m S of NW corner, 15 July 2001, *M. Hislop, F. & J. Hort* MH 2257 (PERTH); Marchagee Track, 23 km E of Brand Highway, 9 June 2002, *M. Hislop* 2693 (PERTH); Boothendarra Nature Reserve, off Boothendarra Rd, 5.2 km E of Dewar Rd, NE of Badgingarra, 16 Aug. 2008, *M. Hislop* 3802 (CANB, MEL, PERTH); Big Soak Plain [S of Alexander Morrison National Park], 1981, *Hood s.n.* (PERTH); Watheroo National Park, W of Watheroo, 5 Oct. 1971, *R.D. Royce* 9610 (PERTH); 35 km W of Watheroo, 2 Nov. 1974, *D.J.E. Whibley* 4979 (AD, PERTH).

**Distribution and habitat.** The main area of distribution is on the uplands of the Dandaragan Plateau between Wotto Nature Reserve, NE of Eneabba and Watheroo National Park (Figure 2), with apparent outliers further south. These outliers are discussed under the notes heading below.



Figure 2. Distribution of *Isopogon panduratus* subsp. *panduratus* (○), *I. panduratus* subsp. *palustris* (●), *I. pruinosus* subsp. *pruinosus* (▲) and *I. pruinosus* subsp. *glabellus* (△) in south-west Western Australia. Also mapped are the two anomalous specimens of *Isopogon panduratus* mentioned in the text, i.e. *E.A. Griffin* 5368 (■) and *F. & J. Hort* 1767 (□).

It grows as a component of species-rich heath, less often Banksia woodland, usually in shallow sandy soils over laterite, but sometimes also in deep white sand.

*Phenology.* The main flowering period is between June and August.

*Conservation status.* Although subsp. *panduratus* does not have a wide distribution in the Geraldton sandplains, it is locally common and is known to occur in a number of National Parks and Nature Reserves. It is therefore not recommended at this stage, for inclusion on the Department of Environment and Conservation's Priority list.

*Notes.* There are two rather anomalous collections at the Western Australian Herbarium from localities well to the south of the species' main area of distribution. The first of these (*E.A. Griffin* 5368) was collected from private property south-east of Dandaragan where it was apparently growing in a seasonal dampland. Despite the habitat, the foliar character is that of the typical subspecies and not subsp. *palustris*. The specimen is anomalous in having a shorter pollen presenter (3.2 mm) than has been otherwise recorded for the species and in the almost complete absence of marginal hairs on the perianth limb. The second outlier (*F. & J. Hort* 1767) is a single roadside plant from a locality north-west of York, which is typical of subsp. *panduratus* except for its non-glaucous leaves and unusually large dimensions. The plant was said to be almost 2 m tall and 3 m across, which is well beyond the usual size range for the typical subspecies.

These two specimens are not assigned here to subspecies and are indicated by their own icons on the distribution map (Figure 2).

**b. *Isopogon panduratus* Hislop & Rye subsp. *palustris* Hislop & Rye, *subsp. nov.***

A subsp. *pandurato* foliis angustioribus profunde concavis, et postea anthesi differt.

*Typus:* south-west of Badgingarra, Western Australia [precise locality withheld for conservation reasons], 15 Aug. 2008, *M. Hislop* 3797 (*holo:* PERTH 07978057; *iso:* CANB, MEL).

*Isopogon* sp. Badgingarra (A.S. George 14200), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed January 2009]

Robust, spreading *shrubs* usually 0.7–2.0 m high, commonly 0.5–1.5 m wide. *Branchlets* usually with a sparse indumentum or glabrous directly below each flower head; hairs 0.4–0.8 mm long. Mature *leaves* deeply concave, 50–80(–100) mm long, 3–8 mm wide. *Outer involucre bracts* glabrous or with a sparse to moderately dense indumentum on abaxial surface, with hairs restricted to the upper half (often occurring in a small, subapical patch), and glabrous or with a sparse to moderately dense indumentum of appressed hairs over distal part of adaxial surface, with a single series of cilia along the lateral margins but sometimes with more cilia at apex, the longest cilia 0.3–0.5 mm long. (Figure 1 L–M)

*Other specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 17 Sep. 1976, *J.S. Beard* 7849 (PERTH); 5 Nov. 1975, *A.S. George* 14200 (PERTH); 17 Oct. 1996, *A.S. George & J.P. Rourke* ASG 17300 (PERTH); 13 Dec. 2006, *A. Harris* LCS 13191 (PERTH); 15 Aug. 2008, *M. Hislop* 3796 (CANB, PERTH); 15 Aug. 2008, *M. Hislop* 3798 (PERTH); 16 Aug. 2008, *M. Hislop* 3800 (CANB, NSW, PERTH); 12 Sep. 2004, *G.J. Keighery & B.J. Keighery* 465 (CANB,



MEL, PERTH); 30 Oct. 1999, *C. MacPherson s.n.* (PERTH); 12 Feb. 2002, *S. McNee s.n.* (PERTH); 31 Oct. 2000, *P. Smith & W. Bancroft s.n.* (PERTH); 26 Nov. 1988, *M. Trudgen s.n.* (PERTH); 1 Oct. 1976, *M. Wittwer W 1836* (PERTH); 12 Nov. 2008, *G. Woodman & B. Taylor OPP 18* (PERTH).

*Distribution and habitat.* Restricted to the coastal plain from north-east of Cervantes south to the Cooljarloo area, north-west of Cataby (Figure 2). In this area it grows in winter-wet sands or sandy loams in heathland communities often dominated by *Banksia telmatiaea*, *Regelia ciliata*, *Beaufortia squarrosa* and *Hakea obliqua* subsp. *parviflora*.

*Phenology.* The main flowering period is between August and October.

*Etymology.* The subspecific epithet is from the Latin *paluster* (belonging to a marsh), a reference to the habitat to which this plant is restricted.

*Conservation status.* The known distribution of this taxon is no more than 30 km (north–south axis) by 20 km (east to west) which includes one confirmed occurrence in Wongonderrah Nature Reserve. Within this area it tends to occur in discrete stands and is often locally common. Threatening processes may include a local spread of the rootrot pathogen *Phytophthora cinnamomi* or the too frequent occurrence of fire. Much of the subspecies' known range also occurs in an area subject to mining development for mineral sands. A systematic search of seasonal wetlands further south, between Cooljarloo and the Moore River, may well be productive in terms of identifying new populations of this taxon. Recently assessed as Priority Two under the Conservation Codes for Western Australian Flora (Smith 2010), under the name *Isopogon* sp. Badgingarra (A.S. George 14200).

*Notes.* Young plants of subsp. *palustris* have more or less flat leaves, like the typical subspecies, but gradually assume the characteristic, deeply concave foliage as the plants mature.

In addition to the foliar differences, the two subspecies can generally be separated by their indumentum. Branchlets of subsp. *palustris* usually have a shorter and sparser indumentum, occasionally more or less glabrous, and hairs on the outer involucre bracts are restricted to the upper half (often occurring only as a small subapical patch), whereas those of the typical subspecies occupy the upper two thirds to three quarters of the bract length. The ciliate margin of the involucre bracts is multi-layered in the typical subspecies but single-layered in the subsp. *palustris*.

There may also be a difference in stature between the two at maturity. Heights of 1.8 or 2 m have been recorded for subsp. *palustris*, but there are no records (apart from the anomalous southern outlier mentioned above) of the typical subspecies growing higher than 1.5 m. Finally there is a difference in flowering time, with the typical subspecies in full flower between June and August and subsp. *palustris* from August to October.

***Isopogon pruinus* Hislop & Rye, *sp. nov.***

*Isopogon pandurato* affinis sed inflorescentia parviore, floribus paucioribus brevioribus, pilis perianthii ad caespes terminalem restrictis differt.

*Typus:* Boolanelling Nature Reserve, Copestakes Rd, Bruce Rock, Western Australia, 4 Aug. 2009, *F. Hort, J. Hort & B. Hort 3425* (*holo:* PERTH 08130884; *iso:* CANB, MEL).

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

Compact, spreading *shrubs* to 2.0 m high and 2.0 m wide, with a fire-sensitive rootstock. *Young branchlets* not or scarcely ribbed, pale brown, reddish-brown or yellow-brown, becoming grey on older wood, with an indumentum of tubercle-based hairs, usually early glabrescent, leaving the surface finely tuberculate, less often the indumentum persistent,  $\pm$  dimorphic, the shorter layer moderately dense, crisped, and overtopped by a much sparser layer of long, straight, appressed hairs to c. 2 mm long. *Leaves* simple, entire, usually glaucous with a persistent, white excrescence, shallowly to steeply antrorse; apex mucronate; lamina narrowly obovate in the upper 2/3–3/4, then tapering gradually to a petiole like portion which expands again slightly at the base, 30–85 mm long, 6–20 mm wide, usually  $\pm$  flat or very shallowly concave adaxially, straight or slightly incurved along the longitudinal axis, thick, the venation obscure except for the midrib and occasionally some secondary venation, sparsely hairy with tubercle-based hairs on young growth, but quickly glabrescent leaving the surfaces of mature leaves finely tuberculate. *Inflorescence* globose or broadly ellipsoid, 15–25 mm diam., (11–)16–32-flowered, terminal or axillary, sessile, usually partially obscured by the subtending leaf bases, solitary or sometimes in small clusters. *Involucral bracts* in 3–4 whorls; the outer bracts ovate or broadly ovate, 5.9–10.5 mm long, 3.1–4.6 mm wide, abaxial surface either densely appressed-hairy for at least the upper 3/4, or glabrous throughout (very occasionally largely glabrous but with a patch of sparse hairs towards the apex), adaxial surface glabrous, apart from a zone of appressed hairs towards the apex, apex mucronate, margins ciliate; the inner bracts, narrowly ovate or narrowly elliptic, often rather asymmetric ( $\pm$  falcate), 6.9–10.5 mm long, 0.9–1.8 mm wide, abaxial surface varying from densely appressed-hairy over most of its length to  $\pm$  glabrous, adaxial surface glabrous apart from a zone of appressed hairs towards the apex, apex acute, margins ciliate throughout. *Cone scales* very narrowly ovate, very narrowly elliptic, very narrowly panduriform or  $\pm$  linear, 6.4–10.5 mm long, 0.7–1.1 mm wide, abaxial surface either with a monomorphic indumentum of dense, silky antrorse hairs throughout or with a weakly dimorphic indumentum of straight, fine hairs in the upper 1/3–1/2 and coarser,  $\pm$  crinkled hairs below, adaxial surface glabrous apart from a zone of hairs towards the apex, apex acute, margins ciliate throughout. *Perianth tube* slightly expanded above the ovary, otherwise filiform, glabrous, pink, 9–20 mm long; *lobes* pink, 4.6–6.4 mm long, the limb 1.9–3.2 mm long, with an apical tuft of straight, white hairs, 0.5–1.2 mm long. *Anthers* 1.6–2.4 mm long. *Style* glabrous, 6–17 mm long. *Pollen presenter* 3.5–5.2 mm long, 0.30–0.55 mm wide; the base narrowly obovoid 1.4–2.7 mm long, densely papillate with retrorse white or yellow papillae, 0.08–0.20 mm long, the constriction usually prominent, papillate or  $\pm$  glabrous; the bulge prominent, papillate with the same indumentum as the base or somewhat sparser; the receptor 1.5–2.3 mm long, tapering gradually towards the stigma, viscid, glabrous throughout or with some papillae towards the base. *Stigma* dilated, cupular. *Cones* globose, 8–12 mm long, 8–12 mm wide. *Nuts* ovoid, 3.0–3.6 mm long, 1.1–1.5 mm wide, with spreading hairs throughout, the longest of these (4–5 mm long) at the base, becoming progressively shorter towards the apex.

*Etymology.* The epithet is derived from the Latin *pruinus* (frosted, covered with hoar frost), a reference to the persistent, white excrescence which is generally a feature of this species.

*Affinities.* Most likely to be confused with either *Isopogon panduratus* from the Geraldton sandplains (distinguishing features between the two are discussed under that species) or the taxon currently known by the phrase-name *I. sp.* Fitzgerald River (D.B. Foreman 813), which has a contiguous distribution to the south. The latter differs in its narrower pollen presenter with shorter, less dense papillae and a shorter receptor, and in its narrower, outer involucral bracts and non-glaucous aspect. *I. sp.* Fitzgerald River (D.B. Foreman 813) was included by Foreman within in his concept of

*Isopogon buxifolius* R Br. *s. lat.* but all of that species' infraspecific taxa have shorter leaves and smaller, often differently shaped pollen presenters.

*Notes.* Two more or less parapatric subspecies are recognised, the typical one with densely hairy bracts occurring in the northern and western part of the species range and the atypical one with the outer bract surface glabrous occurring in the south-east. One specimen of the latter from Hyden (*M. Barrow* 81), just south of the known range of subsp. *pruinus*, has a very sparse indumentum on a central to distal patch on some of its bracts. Although there is only one character difference between the two variants of *I. pruinus*, it causes a striking difference in their appearance and is clearly geographically based.

### Key to subspecies of *Isopogon pruinus*

- 1 Outer and intermediate involucre bracts densely hairy on the abaxial surface (Kwolyin area south to Harrismith and eastwards to NE of Hyden).....subsp. **pruinus**
- 1: Outer and intermediate involucre bracts glabrous on abaxial surface or occasionally with a few hairs towards apex (Lake Grace area to Hyden to Frank Hann National Park).....subsp. **glabellus**

### a. *Isopogon pruinus* Hislop & Rye subsp. **pruinus**

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

*Outer and intermediate involucre bracts* with a dense indumentum of white, antrorse-appressed hairs on abaxial surface. (Figure 3)

*Other specimens examined.* WESTERN AUSTRALIA: 9 km NE of Kondinin trig. point, 28 Jan. 1979, *B. Barnsley* 958 (CANB, NSW, PERTH); Corrigin Reserve, 5 June 1998, *E. Bennett* AS 10.15 (PERTH); Boolanelling Nature Reserve [N of Corrigin], 3 Sep. 1998, *E. Bennett* BO 6.4 (PERTH); VCL No. 9, Site 2, S of Harrismith townsite, 23 Nov. 1999, *E. Bennett & T. Sleep* 9.037 (PERTH); Dudinin, Jitarning Kulin shire, July 1994, *D. Cook* KKD 1A (PERTH); Along track which branches S off Kulin–Dudin Rd, 2.6 km E of Dudinin, 7 May 1997, *R. Davis* 3146 (PERTH); Jingaring Nature Reserve [E of Pingelly], 30 June 1998, *R. Davis* 6370B (PERTH); Private property near Sedgewick Rd, NE of Hyden, 19 Aug. 2001, *J.M. Flint* 258 (PERTH); Anderson Rock Rd, S of Mount Walker bin [E of Narembene], 18 Aug. 2002, *J.M. Flint* 302 (PERTH, CANB); 11 km NW of Jitarning, 20 Nov. 1985, *D.B. Foreman* 1120 (MEL, PERTH); Quadrat 12, Taylor's property 'Woodford', between Tincurrin Line Rd and Harrismith South Rd, approx. 3 km SSW of Harrismith, 30 Aug. 1998, *A.G. Gunness et al.* WOOD 12/09 (PERTH); Bendering Nature Reserve, 27 Aug. 1983, *G.J. Keighery* 6264 (PERTH); On N side of Bendering Reserve Rd, 3.45 km E of Greay Rd, North Karlgarin Nature Reserve [ENE of Kondinin], 22 Sep. 1997, *G.J. Keighery & N. Gibson* 5794 (PERTH); Corrigin town reserve, 13 July 1999, *K. Macey* 2 (PERTH); Middleton Rd, 5 km E of Corrigin South Rd, on road above location 19769, 19 May 1997, *C. Rogers* 432 (PERTH); Boolanelling Nature Reserve, Kwolyin, 19 Sep. 2000, *J.E. Wajon* 270 (PERTH).

*Distribution and habitat.* Distributed in the central wheatbelt of Western Australia south of the Great Eastern Highway, from west of Corrigin to north of Hyden (Figure 2). Grows in sandy soils, mostly over gravel, in heath or open mallee woodland.

*Phenology.* Flowers mainly between June and September.



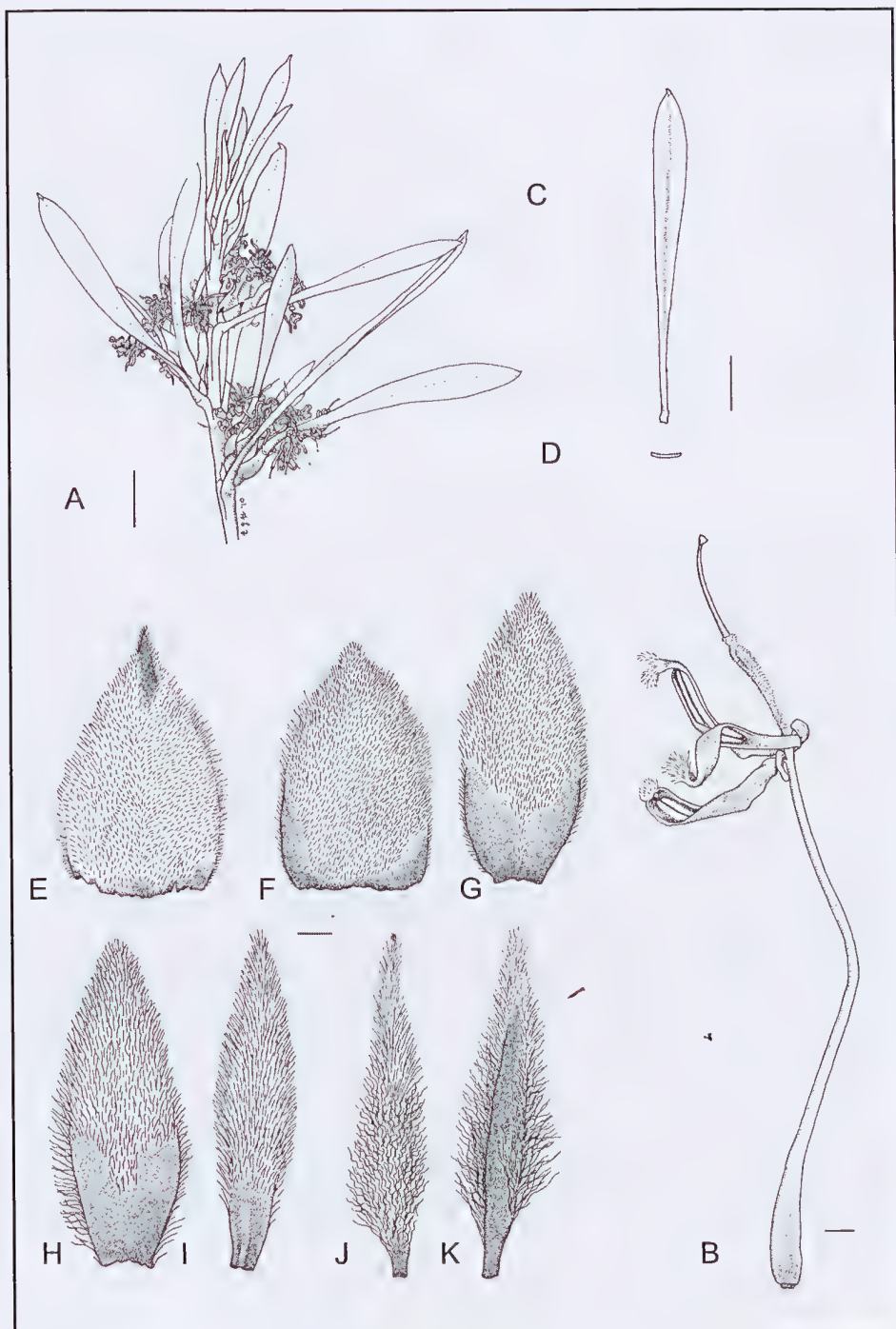


Figure 3. *Isopogon pruinosus* subsp. *pruinosus*. A – flowering branchlet; B – flower; C – leaf, abaxial surface; D – leaf section; E – outer involucral bract, abaxial surface; F–H – intermediate involucral bracts, abaxial surface; I – inner involucral bract, abaxial surface; J – cone scale, abaxial surface; K – cone scale adaxial surface. Scale bars: A, C & D = 10 mm; B, E, F, G, H, I, J & K = 1 mm. Drawn by Ellen Hickman from J.M. Flint 302.

*Conservation status.* The subspecies appears locally common across its range and populations are conserved in a number of Nature Reserves. No conservation coding is recommended here.

*Notes.* A variant of the typical subspecies which occurs in the Harrismith area (e.g. *E. Bennett* & *T. Sleep* 9.037) at the south-eastern limit of its range, apparently lacks the pruinose leaf coating which is characteristic of the species.

**b. *Isopogon pruinosis* Hislop & Rye subsp. *glabellus* Hislop & Rye**

A subsp. *pruinosis* bracteis involucrali glabris vel fere glabris differt.

*Isopogon* sp. Watheroo (D. Foreman 477) *p.p.*, in G. Paczkowska & A.R. Chapman, *West. Austral. Fl.: Descr. Cat.* p. 497 (2000).

*Illustration:* R.M. Sainsbury (1987:11) [as *Isopogon axillaris*]

*Typus:* 20 miles [*c.* 32 km] E of Pingaring, Western Australia, 29 May 1969, *A.S. George* 9345 (*holo:* PERTH 04229215; *iso:* AD, BRI, CANB, K, MEL).

*Outer and intermediate involucral bracts* glabrous on abaxial surface or occasionally with a few hairs towards the apex.

*Other specimens examined.* WESTERN AUSTRALIA: 90 Mile Tank, between Salmon Gums and Lake King, 18 June 1974, *T.E.H. Aplin* 5898 (CANB, K, PERTH); Hyden, 8 Sep. 1966, *M. Barrow* 81 (PERTH); Dragon Rocks Nature Reserve, 18 Aug. 1998, *M. Braimbridge* & *C. Godden* DS 8.11 (PERTH); 16.25 km NNE of Coujinup Hill [NE of Ravensthorpe], 11 Aug. 1983, *M.A. Burgman* & *S. McNee* MAB 1958 (PERTH); 0.6 km E of the 90 Mile Tank on the Lake King–Norseman Rd, 113 km NE of Lake King, 16 June 2006, *G. Byrne* 2086 (CANB, PERTH); Dragon Rocks Nature Reserve no. 36128, S boundary, 7 June 1991, *A.M. Coates* 2293 (PERTH); 13 km N of Mt. Maxwell [N of Bremer Bay], 13 May 1996, *R. Davis* RD 719 (PERTH); Lake King–Norseman Rd, 30.1 km E of Ladyman Rd, Frank Hann National Park, 16 May 2002, *M. Hislop* & *F. Hort* MH 2594 (CANB, PERTH); N of Digger Rock [Digger Rocks, E of Varley], 10 Dec. 1964, *F. Lullfitz* 4000 (PERTH); Frank Hann National Park, 11 July 1978, *D. Monk* 45 (PERTH); ‘Buckleys Breakaway’, 56 km E of Kulin, 5 July 1997, *S. Murray* 263 (CANB, MEL, PERTH); 10 km SSE of Mt Gibbs, Frank Hann National Park, *c.* 35 km ENE of Lake King, 22 July 1979, *K. Newbey* 5434 (PERTH).

*Distribution and habitat.* Occupies the south-eastern portion of the species’ range, from south-west of Hyden to the eastern end of Frank Hann National Park, with an apparent outlier well to the south in the Fitzgerald River National Park (Figure 2). There appears to be no difference in habitat preference between the two subspecies.

*Phenology.* The main flowering period is between June and September.

*Etymology.* From the Latin *glabellus* (without hairs), a reference to the glabrous or almost glabrous involucral bracts.

**Conservation status.** The distribution of subsp. *glabellus* extends from the relatively well-vegetated south-eastern part of the wheatbelt eastwards to beyond the agricultural zone. In this area it is known to occur in several Nature Reserves and National Parks. No conservation coding is recommended here.

**Notes.** There are two problematic collections from the southern edge of the subspecies' range (*D.B. Foreman* 783 from east of Lake Grace and *D.B. Foreman* 794 from south-east of Lake King). In regard to some critical aspects of their morphology they approach the unnamed taxon, *Isopogon* sp. Fitzgerald River (*D.B. Foreman* 813), discussed under the Affinities heading above. Both lack the pruinose leaf texture of *I. pruinosus* and while their involucre bract character is of that species, the morphology of the pollen presenter is somewhat intermediate with *I. sp.* Fitzgerald River (*D.B. Foreman* 813). Although these specimens are tentatively ascribed here to *I. pruinosus*, subspecific rank has not been applied and they are not included in the distribution maps. Their status will need to be reviewed when *I. sp.* Fitzgerald River (*D.B. Foreman* 813) is formally circumscribed.

### Acknowledgements

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## ***Calothamnus* (Myrtaceae): precursor paper to *Flora of Australia***

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### **Abstract**

George, A.S. *Calothamnus* (Myrtaceae): precursor paper to *Flora of Australia*. *Nuytsia* 20: 183–200 (2010). The following new taxa are described: *Calothamnus arcuatus* A.S.George, *C. borealis* subsp. *cinereus* A.S.George, *C. cupularis* A.S.George, *C. montanus* A.S.George, *C. phellosus* A.S.George (the species previously known as *C. oldfieldii*), *C. roseus* A.S.George and *C. scabridus* A.S.George. *Calothamnus blepharospermus* var. *glaber* Benth. is raised to specific rank. The name *Calothamnus lateralis* f. *crassus* Benth. (*C. crassus* (Benth.) Hawkeswood) is shown to have been misapplied by Hawkeswood and is given varietal rank under *C. lateralis*. *Calothamnus blepharatherus* (a synonym of *C. sanguineus* Labill.), *C. blepharospermus* F.Muell. and *C. chrysanthereus* F.Muell. are lectotypified. *Calothamnus oldfieldii* F.Muell. is also lectotypified and the name correctly applied, with *C. kalbarriensis* Hawkeswood reduced to synonymy.

### **Introduction**

An account of *Calothamnus* Labill. is being prepared for the *Flora of Australia* (George, in preparation) but, as its publication is some time off, new taxa, combinations and typifications are published here and in an associated paper on *Calothamnus quadrifidus* R.Br. (George & Gibson, 2010). Since Hawkeswood published several papers (1984, 1985, 1987), much new material has been collected, including the new taxa here described and collections that have allowed re-interpretation of some previously-named taxa. Study of type collections has also led to some new interpretations.

### **Methods**

The work is based on a morphological study of herbarium material as well as field work. The concepts for species and subspecies follow those outlined in George (1996). Taxa are arranged alphabetically.

### **Taxonomy**

***Calothamnus arcuatus* A.S.George, *sp. nov.***

Ad *Calothamnus hirsutum* Hawkeswood affinis, a qua habitu lignotubero, foliis patentibus arcuatis pungentibus glabris differt.

*Typus*: Nebroo Reserve, Western Australia [precise locality withheld for conservation reasons], 18 November 2009, A.S. George 17801 (*holo*: PERTH 08178445; *iso*: CANB, K, MEL, NSW).

Erect or spreading *shrub* to 1.5 m tall and 2 m wide, with lignotuber. *Bark* somewhat flaky or fibrous. *Stems* glabrous. *Leaves* widely spreading but gently curved upwards, terete, pungent, 2–5 cm long, 0.7–1.1 mm wide, glabrous. *Flowers* 5-merous (rarely 6-merous), in small groups among or below oldest leaves. *Hypanthium* 4–4.5 mm long, silky with reflexed hairs. *Sepals* ovate, 2–3 mm long, reflexed-silky, the inner ones and overlapped edges of outer ones with dense crimped hairs. *Petals* ovate, 2.5–3 mm long, finely erose on outer margin. *Staminal bundles* 22–25 mm long, bright red. *Pistil* 21–28 mm long. *Fruit* globose or depressed-globose, 5–6 mm long, smooth or slightly corky when mature; sepals persistent for a year or so but not woody, then falling. *Seeds* 1–1.2 mm long, smooth, brown. (Figure 1)

*Selected specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons], J. Borger CH 244-1 (PERTH); J. Borger BR 086-2 (PERTH); L.A. Craven & C. Chapman 6891 (CANB, PERTH); M. Hislop 3901 (PERTH); S. Patrick 4503 (PERTH).

*Distribution and habitat*. Occurs north-east of Eneabba and, disjunctly, north-east of Arrino, south-western Western Australia. Grows in shallow sandy loam over sandstone or siltstone on slopes near creeks, in kwongan, and in yellow sand over gravel.

*Phenology*. Flowers recorded in April, June and August. Autumn and early winter appear to be the normal flowering period (A. Tinker, pers. comm.).

*Conservation status*. Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: Priority Two (Smith 2010). Known from four populations over a range of 40 km. One is in a nature reserve.

*Etymology*. The Latin *arcuatus* (curved like a bow) refers to the leaves.

*Affinities*. This is apparently related to *Calothamnus hirsutus* Hawkeswood but is a stouter plant with a lignotuber, the leaves typically widely spreading and pungent. *C. hirsutus* usually occupies low-lying sites in deep sandy loam but is present with *C. arcuatus* at the type locality. The collection by M. Hislop from north-east of Arrino (growing in yellow sand over gravel at the edge of a thicket) is described in the collection notes as ‘glaucous’, whereas the foliage is typically bright to deep green.

*Note*. A collection by A. Tinker (PERTH) has 6-merous flowers, the only specimen seen in the genus with this attribute.

***Calothamnus blepharanthus*** F.Muell., *Fragm.* 3: 111 (1862) as *blepharanthus*. *Type citation*: ‘In plagis aridis ad flumen Murchison. Oldfield’ [i.e. On arid plains towards the Murchison River, Western Australia, A. Oldfield] (*lecto*, here chosen: MEL 105166).

At MEL there are two collections by Oldfield annotated with this name by Mueller. Besides the above there is one with the locality ‘Okagee’ [= Oakagee?] but this is near Champion Bay, well south of the Murchison River, and is here discounted as type material, although it was labelled holotype by Hawkeswood (1987). The sheet selected as lectotype has flowers and fruit and agrees with the protologue. The name is a synonym of *Calothamnus sanguineus* Labill.





Figure 1. *Calothamnus arcuatus*. Holotype, north-east of Eneabba, A.S. George 17801 (PERTH 0817445). Scale bar = 5 cm.

**Calothamnus blepharospermus** F.Muell., *Fragm.* 3: 112 (1862) as *blepharosperma*. *Type citation*: 'In deserto ad flumen Murchison. Oldfield' [i.e. In the desert towards the Murchison River, Western Australia, *A. Oldfield*] (*lecto*, here chosen: MEL 105173 [left-hand specimen]; *isolecto*: MEL 105174 [upper left and right-hand specimens]).

The collections annotated by Mueller represent the same species but are probably from different localities and evidently from different plants. MEL 105173 and MEL 105174 have the locality 'Murchison R.' while MEL 105175 is labelled 'near Minaru' and MEL 105176 appears to have the same locality (Oldfield's writing is unclear). The left-hand specimen (of two) on MEL 105173 has spirally-twisted lower leaves, as do the upper left and right-hand specimens on MEL 105174. The largest specimen on MEL 105174 has leaves of similar length but they are not twisted. The right-hand specimen on MEL 105173, the lower central specimen on MEL 105174 and the single specimens on MEL 105175 and MEL 105176 have shorter leaves than the others. Mueller described flowers and fruit, but no specimen has both, nor have any seeds survived on any sheet. Hawkeswood annotated MEL 105175 as holotype on 11 June 1984 but this is one of the short-leaved specimens that are less typical of the species as now known, and has just one damaged flower. I suggest that the left-hand specimen on MEL 105173, in fruit, best represents the species and here select it as lectotype.

**Calothamnus borealis** Hawkeswood subsp. **cinereus** A.S.George, *subsp. nov.*

Ab *C. boreali* Hawkeswood subsp. *boreali* ut sequente differt: folia anguste linearia, crassa, plerumque 1.5–2 mm lata, indumento persistente; fructus 8–10 mm longus, sepalis persistentibus ut pote lobis lignosis.

*Typus*: Kennedy Range, Western Australia [precise locality withheld for conservation reasons], 20 September 1991, *Peter G. Wilson* 1191 & *R. Rowe* (*holo*: PERTH 02116510; *iso*: L, MO, NSW).

*Leaves* narrowly linear but thick, usually 1.5–2 mm wide, the indumentum persistent. *Fruit* 8–10 mm long, the sepals persistent as woody lobes. (Figure 2)

*Selected specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons], *J.S. Beard* 4375 (PERTH); *R. Cranfield* 1899 (PERTH).

*Distribution and habitat*. Occurs in the Kennedy Range, Western Australia. Grows in red sand on flats and dunes.

*Phenology*. Flowers July–September.

*Conservation status*. DEC Conservation Codes for Western Australian Flora: Priority Three (Smith 2010). Known from a small area in the Kennedy Range National Park.

*Etymology*. The Latin *cinereus* (ash grey) refers to the leaves.

*Notes*. This has quite the appearance and morphology of typical *C. borealis* but the wider leaves give it a coarser aspect and the indumentum persists longer.

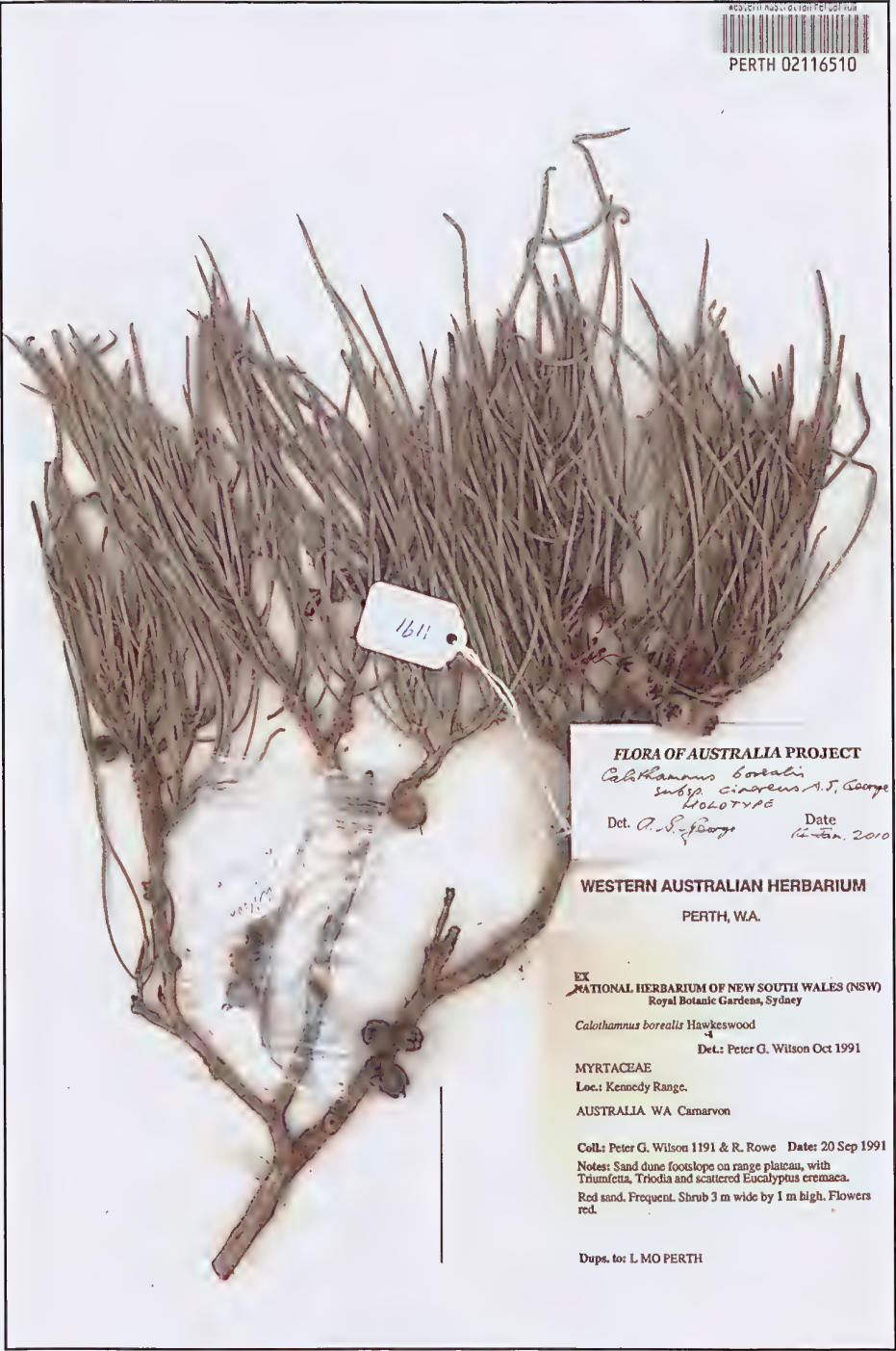


Figure 2. *Calothamnus borealis* subsp. *cinereus*. Holotype, Kennedy Range, Peter G. Wilson 1191 & R. Rowe (PERTH 02116510). Scale bar = 5 cm.



***Calothamnus chrysanthereus*** F.Muell., *Fragm.* 3: 112 (1862) as *chrysantherea*. *Type citation*: ‘In vallibus collium calcariorum juxta fluminis Murchison. Oldfield’ [i.e. In valleys of calcareous hills next to the Murchison River, Western Australia, 18--., *A. Oldfield*] (*lecto*, here chosen: MEL105183; *isolecto*: BM, K (2 sheets), MEL (5 sheets, see below), P).

At the National Herbarium of Victoria there are six sheets collected at the Murchison River by Oldfield and annotated as *Calothamnus chrysanthereus* (or *chrysantherea*) by Mueller—MEL 105178, 105179, 105180, 105181, 105182, 105183. From Oldfield’s field labels it is clear that these are more than one gathering (probably three); all are the same species but it seems preferable to select a lectotype. The best sheet is MEL 105183, annotated as holotype by Hawkeswood on 11 June 1984. This is here selected as lectotype.

The epithet has long been spelt *chrysanthera* or *chrysantherus* but Mueller (1862–63) used the form *chrysantherea* in both the protologue and the index of volume 3 of the *Fragmenta*, as well as in volume 10 (Mueller 1876–77: 31). His annotations on sheets at MEL also give *chrysantherea* and *chrysanthereus*. The latter spelling is here restored.

***Calothamnus cupularis*** A.S.George, *sp. nov.*

· *Ad Calothamnium formosum* Hawkeswood affinis, sed floribus majoribus (hypanthio 5.5–6.5 mm longo, staminibus 35–38 mm longis) et fructibus majoribus (12–14 mm longis), praecipue differt.

*Typus*: north-west of Highway 1 along road to Kalbarri [Kalbarri NationalPark], Western Australia [precise locality withheld for conservation reasons], 30 September 1979, *M.D. Crisp* 6266, *J. Taylor & R. Jackson* (*holo*: PERTH 02324997; *iso*: CANB).

*Calothamnus* sp. Junga (S.D. Hopper 1293), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

*Shrub* to 1.2 m tall with? lignotuber. *Stems* hirsute, glabrescent. *Leaves* terete, pungent, 4–10 cm long, 1–1.3 mm wide. *Flowers* 5-merous. *Hypanthium* 5.5–6.5 mm long, glabrous or hirsute. *Sepals* with prominent, thickened, tapering ‘midrib’ and wide, scarious margins, 3.5–4 mm long, variably hirsute, pubescent or partly glabrous. *Petals* glabrous, 7–8 mm long. *Staminal bundles* equal, 35–38 mm long, bright red. *Pistil* 38–40 mm long. *Fruit* almost cylindrical, smooth, 12–14 mm long; sepals persistent for a year or so, then falling leaving low lobes. *Seeds* 3.5–4 mm long, papillose on angles. (Figure 3)

*Selected specimens examined*. WESTERNAUSTRALIA: [localities withheld for conservation reasons], S.D. Hopper 1293 (PERTH); A. Strid 20810 (PERTH, S).

*Distribution and habitat*. Known from a small area in Kalbarri National Park, south-western Western Australia. Grows in yellow sand in kwongan.

*Phenology*. Flowers September–October.



Figure 3. *Calothamnus cupularis*. Holotype, Kalbarri National Park, M.D. Crisp 6266, J. Taylor & R. Jackson (PERTH 02324997). Scale bar = 5 cm.

*Conservation status.* Listed by Smith (2010) as Priority Two under DEC Conservation Codes for Western Australian Flora under the name *Calothamnus* sp. Junga (S.D. Hopper 1293). Known from several populations in a small area in Kalbarri National Park.

*Etymology.* The Latin *cupularis* (cup-like) refers to the fruit.

*Affinities.* Similar to *C. formosus* Hawkeswood but with much larger flowers and fruit.

*Notes.* Collections by S.D. Hopper 1293 (PERTH) and M.D. Crisp 6268 (CANB, PERTH) have the hypanthium almost glabrous except the sepals. *Strid* 20810 is hirsute throughout.

***Calothamnus glaber* (Benth.) Hawkeswood ex A.S.George, *stat. nov.***

*C. blepharospermus* var. *glaber*, Benth., *Fl. Austral.* 3: 176 (1867). *Type:* near the Murchison River, Western Australia, 18--., *A. Oldfield* (*holo:* K; *iso:* MEL 105168, MEL 105170, MEL 105171).

Trevor Hawkeswood annotated sheets at PERTH in 1979 but never published the combination, although it was listed as an invalid combination in Paczkowska and Chapman (2000). The taxon differs consistently from *C. blepharospermus* in being glabrous. Mueller referred to it in his protologue of *C. blepharospermus* thus: 'Vidi ex eodem loco plantam non nisi glabrities, ut apparet, diversam', i.e. I have seen from the same place a plant different, as it seems, in its glabrous state. The sheet MEL 105170, with Oldfield's detailed notes, was annotated 'var.' by Mueller.

***Calothamnus lateralis* Lindl. var. *crassus* (Benth.) A.S.George, *stat. nov.***

*C. lateralis* f. *crassus* Benth., *Fl. Austral.* 3: 177 (1867); *Calothamnus crassus* (Benth.) Hawkeswood, *Nuytsia* 6: 86 (1987). *Type:* south-western Western Australia, 184--., *J. Drummond* 2: 73 (*lecto:* K *fide* T.J. Hawkeswood, *Nuytsia* 6: 86 (1987); *isolecto:* BM, K, NSW, OXF, P; south-western Western Australia, *J. Drummond* 37; *syn:* K).

*Calothamnus* sp. Scott River (R.D. Royce 84), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

The name *Calothamnus lateralis* f. *crassus* Benth. was raised to specific rank by Hawkeswood (1987) and misapplied to a taxon endemic in the Stirling Range, described below as *Calothamnus montanus*. In fact, it is a taxon from far south-western Western Australia known as '*Calothamnus* sp. Scott River (R.D. Royce 84)' and not sufficiently distinct from *C. lateralis* Lindl. to maintain at specific rank. Typical plants are much more robust and have shorter leaves than that species but there is much variation and the two cannot be separated by any reliable character. Bentham's form is here given varietal rank.

Confirmation of the application of the name *C. crassus* came from a loose inflorescence of a *Grevillea* that was caught up in the syntype at Kew. These turned out to be *G. papillosa* (McGill.) P.M. Olde & N.R. Marriott, a species confined to the Scott River and Nannup area. Drummond visited this region in 1842 and sent his specimens to England as his First Collection in 1843 and 1844. He visited the Stirling Range twice later in the 1840s and sent this material in his Fourth and Fifth Collections. It is highly unlikely that flowers from the Scott River could have been mixed with a specimen from the Stirling Range.



***Calothamnus montanus* A.S. George, *sp. nov.***

Frutex erectus ad 2 m altus, sine lignotubero? Caules breviter villosi, glabrescentes, spissescentes. Folia teretia, 3.5–11 mm longa, 0.8–1 mm lata, hirsuta, glabrescentia. Flores 4-meri, conferti. Hypanthium immersum, 2–2.5 mm longum, glabrum; sepala 0.7–1 mm longa. Petala 2.5–3 mm longa. Fasciculi staminales 25–28 mm longi, rubri et virides. Pistillum 20–25 mm longum. Fructus depresso-globosus, 3–5 mm longus, glaber; sepala persistentia, 2 incurva et quam alia majora. Semina 0.7–1.2 mm longa, laevia.

*Typus*: Bluff Knoll [Stirling Range], Western Australia [precise locality withheld for conservation reasons], 12 November 1961, *A.S. George* 3140 (*holo*: PERTH 01074792).

*Calothamnus crassus* auct. non (Benth.) Hawkeswood: Hawkeswood, *Nuytsia* 6: 86 (1987)

*Calothamnus* sp. Montane (A.S. George 3140), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

Erect *shrub* to 2 m, without? lignotuber. *Stems* shortly villous, glabrescent, becoming thick. *Leaves* terete, 3.5–11 mm long, 0.8–1 mm wide, openly hirsute, glabrescent. *Flowers* 4-merous, crowded, arranged on one side or quite surrounding stem. *Hypanthium* immersed, 2–2.5 mm long, glabrous. *Sepals* 0.7–1 mm long. *Petals* 2.5–3 mm long. *Staminal bundles* 25–28 mm long, red and green. *Pistil* 20–25 mm long. *Fruit* depressed-globose, 3–5 mm long, glabrous; sepals persistent, 2 incurved and larger. *Seeds* 0.7–1.2 mm long, smooth. (Figure 4)

*Selected specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons], *S. Barrett* 97 (PERTH); *S. Barrett* 1041 (PERTH); *J.A. Cochrane* 5580 & *R. Hartley* (PERTH).

*Distribution and habitat*. Occurs in the Stirling Range, south-western Western Australia, generally above 800 m. Grows in quartzitic schist meta-sandstone soil in shrubland or woodland.

*Phenology*. Flowers October–January.

*Conservation status*. Recently listed as Priority Four under DEC Conservation Codes for Western Australian Flora. Known from several populations in the Stirling Range National Park.

*Etymology*. From the Latin *montanus* (montane), in reference to the occurrence.

*Affinities*. This is distinguished from *C. lateralis* by the villous young stems, generally shorter leaves and paler stamens that may be partly green; it has longer stamens than *C. lateralis* var. *crassus* which also has the thickened stems characteristic of *C. montanus*. In specimens from the eastern part of the Range the leaves are glabrous from the start.

***Calothamnus oldfieldii*** F. Muell., *Fragm.* 3: 113 (1862). *Type citation*: ‘In collibus arenosis apud ostium fluminis Murchison. Oldfield’ [i.e. On sandy hills near mouth of Murchison River, Western Australia, 18--., *A. Oldfield*] (*lecto*, here chosen: MEL 105193; *isolecto*: K (2 sheets), MEL 105192).



Figure 4. *Calothamnus montanus*. Holotype, Stirling Range, A.S. George 3140 (PERTH 01074792). Scale bar = 5 cm.

*Calothamnus kalbarriensis* Hawkeswood, *Nuytsia* 5: 147 (1984). Type: c. 5 km inland from Zuytdorp Cliffs, 40 km WSW of Cooloomia Homestead, Western Australia, 15 September 1979, S.D. Hopper 1327 (holo: PERTH; iso: CANB).

The five sheets of material at MEL collected at the Murchison River by Oldfield and annotated as *Calothamnus oldfieldii* by Mueller bear two entities. MEL 105192 and MEL 105193 are the species described by Hawkeswood (1984) as *C. kalbarriensis*; both have the Oldfield number 1134, and 105193 has his field label with the locality 'Pillyandie-Nat the mouth of Murchison R'. MEL 105194 and MEL 105197 are the species described below as *C. phellosus*; neither has an Oldfield label but both are annotated 'Murchison R.' in Mueller's hand. MEL 105196 is the same species; Oldfield's field label on this sheet has the locality 'Limestone Hills W of Yarrhos' and his number 794; the sheet was annotated by Hawkeswood as lectotype on 11 June 1984 but he never published this. Unfortunately, the specimens that best fit Mueller's protologue are those on MEL 105192 and MEL 105193: Mueller italicised '*Foliis breviusculis muticis teretiusculis*' (the italic indicating a significant attribute) and gave their length as ' $\frac{3}{4}$ – $1\frac{1}{2}$ "' (c. 2–3 cm) long, and the fruit as almost ' $\frac{1}{2}$ "' (c. 12 mm) long. These attributes are those of *Calothamnus kalbarriensis* (leaves 1.5–2.5 cm long, fruit 10–12 mm long), whereas *C. oldfieldii* as recently known has leaves typically 3–8 cm long and fruit 7–10 mm long; this species has fruit with a corky bark, as represented on MEL 105194 and MEL 105197. Further, Mueller cited an Oldfield collection gathered on sand hills near the mouth of the Murchison River, and these details are given for sheet 105192 and its duplicate 10593. The sheet MEL 105193 has the best specimens and is here selected as lectotype, MEL 105192 being an isoelectotype. While it is unfortunate that the well-known name *C. oldfieldii* is shown to have been misapplied, and *C. kalbarriensis* is a well-established name, the evidence from the type material and the protologue leaves no choice but to apply the name *oldfieldii* correctly and publish a new name for the entity that has been known as *C. oldfieldii* (*C. phellosus*, see below).

***Calothamnus phellosus* A.S. George, sp. nov.**

Ad *Calothamnum formosum* Hawkeswood affinis, a qua habitu majore (ad 4 m alto, 6 m lato), lignotubero, hypanthio pubescente vel tomentoso, et fructu minore (7–11 mm longo) cortice suberoso, differt.

*Typus*: North-West Coastal Highway, 9.8 km north of Eurardy Station entrance, Western Australia, 27° 29' S, 114° 43' E, 13 September 2004, A.S. George 17627, R.K. Brummitt & E.G.H. Oliver (holo: PERTH 07002009; iso: K).

*Calothamnus oldfieldii* auct. non F. Muell.

Erect shrub to 4 m tall and 6 m wide, with lignotuber. Stems pubescent or tomentose, glabrescent. Leaves terete, acute, pungent, 2.5–8 cm long, 0.7–1.1 mm wide, glabrous, or sparsely hirsute and glabrescent. Flowers 5-merous, commonly in small groups among or below leaves. Hypanthium 3–4.5 mm long, sparsely to densely pubescent, or tomentose. Sepals  $\pm$  equal, 1.3–2 mm long, pubescent to tomentose. Petals 4–4.5 mm long. Staminal bundles 22–30 mm long, bright red. Pistil 18–30 mm long. Fruit depressed-globose but irregular when closely packed, 7–11 mm long, soon developing corky bark; sepals not enlarged, initially persistent. Seeds 2.8–3 mm long, papillose on angles. (Figure 5)

*Selected specimens examined*. WESTERNAUSTRALIA: 20 km SE of Z-bend turnoff on Kalbarri–Ajana road, D.E. Albrecht 4193A & B. Fuhrer (MEL, PERTH); 12 km W of Mullewa, L.A. Craven & F.A.



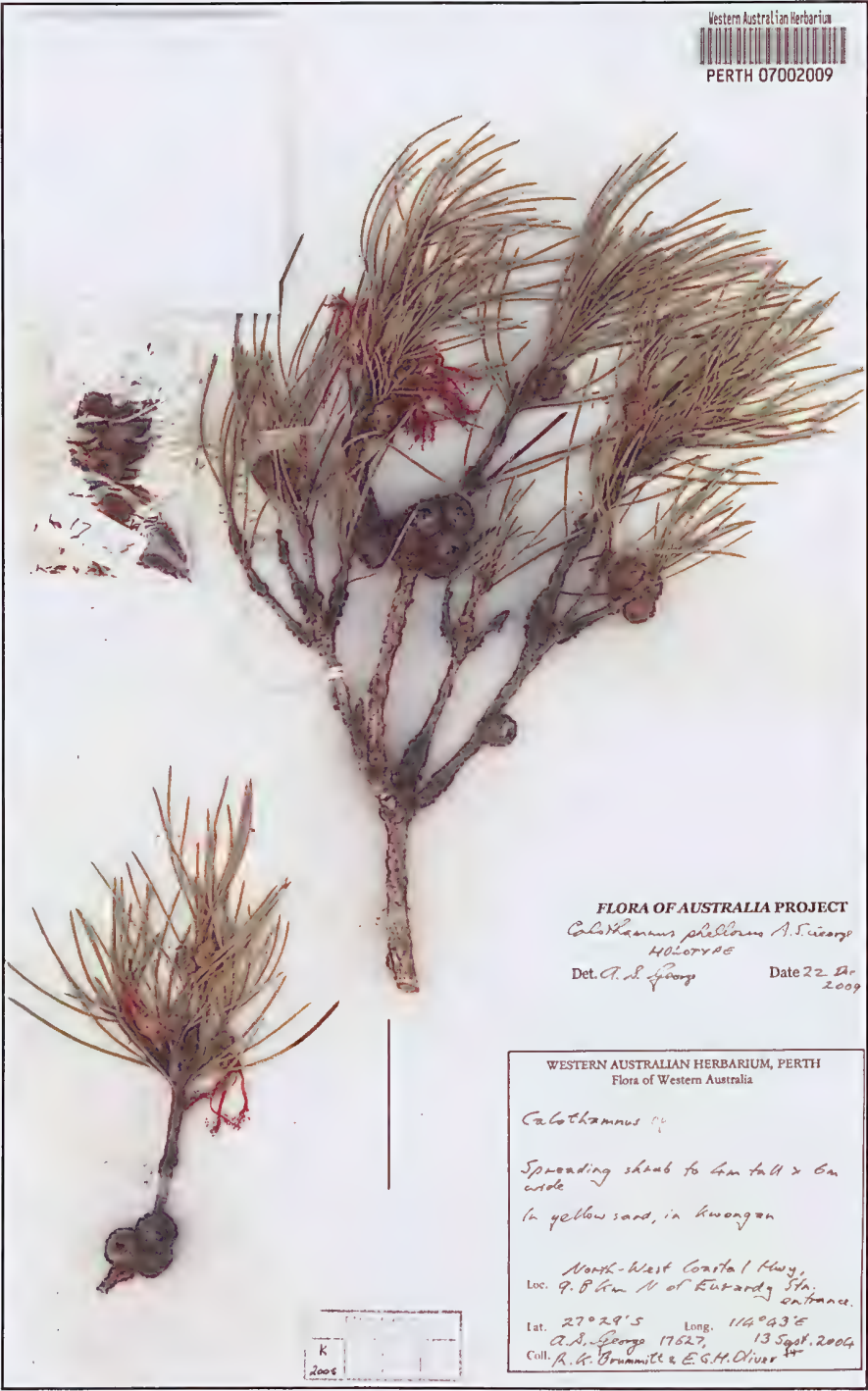


Figure 5. *Calothamnus phellosus*. Holotype, north of Eurardy Station turnoff, North West Coastal Highway, A.S. George 17627, R.K. Brummitt & E.G.H. Oliver (PERTH 07002009). Scale bar = 5 cm.

Zich 8719 (CANB, PERTH); NNE of Northampton, *J. D'alonzo* 563 (PERTH); north of Whelarra, *A.S. George* 17634, *R.K. Brummitt* & *E.G.H. Oliver* (K, PERTH); 6.6 km N of Binnu, North West Coastal Highway, *R.W. Purdie* 3828 (CANB, PERTH).

*Distribution and habitat.* Occurs between Eurardy Station, Northampton and Yuna, south-western Western Australia. Grows in deep yellow sand or sand over laterite, in kwongan or shrubland.

*Phenology.* Flowers September–November.

*Conservation status.* Not threatened.

*Etymology.* The Greek *phellosus* (corky) refers to the bark of the fruit.

*Affinities.* This species resembles *C. formosus* which is non-lignotuberos, has a hypanthium that is glabrous or pubescent only towards base, and a fruit that is usually larger and warted. It is also related to *C. oldfieldii* but is a much larger shrub and has longer leaves that taper more gradually to the apex, and fruit that quickly develop a corky bark.

*Notes.* As discussed above under *Calothamnus oldfieldii*, this species has been known by that name virtually since its publication. When Hawkeswood studied the type material at MEL he recognised that some specimens are the species that he named *C. kalbarriensis* but apparently did not check them against Mueller's protologue. He maintained the traditional application of the name *oldfieldii*, based on a presumed syntype that does not match Mueller's description.

***Calothamnus planifolius* var. *pallidifolius*** Benth., *Fl. Austral.* 3: 177 (1867) *Type:* south-western Western Australia, 184-, *J. Drummond* 40 (*lecto*, here chosen: K); south-western Western Australia, 184-, *J. Drummond* 2: 72 (*syn:* BM, CGE, E, K (2 sheets), NSW, OXF, P).

Hawkeswood (1987: 103), stated that he selected the NSW sheet of *Drummond* 2: 72 as lectotype, but this contradicts the ambiguous statement on p. 100 which cited both a sheet at K and one at NSW after 'lecto, here designated', and the photograph of the NSW sheet on p. 101 is clearly annotated by him as 'isolectotype'. This sheet is a duplicate received from BM in 1915 and was not annotated by Bentham. Of the syntype sheets at K (all annotated by Bentham), that of *Drummond* 40 is better material than the two of *Drummond* 2: 72 and is a better choice as lectotype.

***Calothamnus roseus*** A.S. George, *sp. nov.*

Ad *Calothamnus rupestrem* Schauer affinis, a qua foliis plerumque longioribus (25–45 mm longis), hypanthio indumento reflexo, fasciculis staminalibus roseis, pistillo brevioribus (20–25 mm longo), et fructu majore (13–16 mm longo), differt.

*Typus:* south-east of Ravensthorpe, Western Australia [precise locality withheld for conservation reasons], 29 September 2004, *A.S. George* 17657 & *E.G.H. Oliver* (*holo:* PERTH 06996809; *iso:* AD, CANB, K, MEL, NSW, PERTH).

*Calothamnus* sp. Kundip (A.S. George & E.G.H. Oliver ASG 17657), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

*Shrub* to 2.5 m without lignotuber. *Bark* flaking in coarse strips. *Stems* glabrous. *Leaves* terete, pungent, 25–45 mm long, 0.5–0.7 mm wide, smooth. *Flowers* not or slightly immersed, 4-merous, mostly below leaves, strongly scented. *Hypanthium* 5–6 mm long, pubescent with reflexed hairs. *Sepals* 3.5–4 mm long, pubescent both sides. *Petals* 6–7 mm long, falling at anthesis. *Staminal bundles* equal, 28–33 mm long, deep pink. *Pistil* 20–25 mm long, strongly downcurved. *Fruit* ovoid, 13–16 mm long, smooth; 2 sepals enlarged, persistent, woody, 2 not enlarged, turned outwards, wearing off. *Seeds* narrow, 2–2.5 mm long, angular, smooth. (Figure 6)

*Selected specimens examined.* WESTERNAUSTRALIA: [localities withheld for conservation reasons], *S.D. Hopper* 4390 (PERTH); *K. Newbey* 2495 (PERTH).

*Distribution and habitat.* Occurs south of Ravensthorpe, south-western Western Australia. Grows in rocky, quartzitic soil in tall mallee shrubland.

*Phenology.* Flowers September–November.

*Conservation status.* Listed by Smith (2010) as Priority One under DEC Conservation Codes for Western Australian Flora under the name *Calothamnus* sp. Kundip (A.S. George & E.G.H. Oliver ASG 17657). Known from several populations over a range of c. 10 km.

*Etymology.* The Latin *roseus* (rose-pink) refers to the colour of the stamens.

*Affinities.* This differs from *C. rupestris* Schauer in the generally longer leaves, reflexed indumentum of the hypanthium, deep pink staminal bundles, shorter pistil and larger fruit. *Calothamnus rupestris* occurs around granitic outcrops along the Darling Scarp near Perth and at Boyagin Rock, with an outlier in sandy soil west of Wongan Hills.

***Calothamnus scabridus* A.S. George, sp. nov.**

Frutex erecto-patens ad 1.5 m altus, sine lignotubero. Caules glabri. Folia teretia, acuta, pungentia, 2–7 cm longa, 0.8–1 mm lata, scabrida, cetera glabra. Flores 4-meri, inter vel infra folia vetusissima. Hypanthium immersum, 1.5–2 mm longum, glabrum; sepala 0.8–1 mm longa. Petala 1.8–2 mm longa. Fasciculi staminales 23–28 mm longi, aequales, pallide ad clare rubri. Pistillum 22–24 mm longum. Fructus depresso-globosus, laevis, 3–4 mm longus; 2 sepala persistentia, incurva. Semina 0.8–1 mm longa, laevia.

*Typus:* south-east of Manjimup [north-west of Denmark], Western Australia [precise locality withheld for conservation reasons], 7 November 1995, *A.R. Annels & R.W. Hearn* 5537 (*holo:* PERTH 04247531; *iso:* CANB, K, MEL, NSW, PERTH).

*Calothamnus* sp. Mt Lindesay (A.R. Annels et al. 4539), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].

*Calothamnus* sp. Mt Lindesay (B.G. Hammersley 439), Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 11 December 2009].





Figure 6. *Calothamnus roseus*. Holotype, south-east of Ravensthorpe, A.S. George 17657 & E.G.H. Oliver (PERTH 06996809). Scale bar = 5 cm

Erect *shrub* to 1.5 m, without lignotuber. *Stems* glabrous. *Leaves* terete, acute, pungent, 2–7 cm long, 0.8–1 mm wide, scabrid, otherwise glabrous. *Flowers* 4-merous, among or below oldest leaves, around stem. *Hypanthium* immersed, 1.5–2 mm long, glabrous. *Sepals* 0.8–1 mm long. *Petals* 1.8–2 mm long. *Staminal bundles* equal, 23–28 mm long, pale to bright red. *Pistil* 22–24 mm long. *Fruit* depressed-globose, smooth, 3–4 mm long; 2 sepals persistent, incurved. *Seeds* 0.8–1 mm long. (Figure 7)

*Selected specimen examined.* WESTERNAUSTRALIA: [locality withheld for conservation reasons], G.J. Keighery 12295 (PERTH).

*Distribution and habitat.* Restricted to two peaks north-west of Denmark, south-western Western Australia, in granitic loam in heath and mallee shrubland.

*Phenology.* Flowers October–December.

*Conservation status.* Listed by Smith (2010) as Priority Two under DEC Conservation Codes for Western Australian Flora under the name *Calothamnus* sp. Mt Lindesay (B.G. Hammersley 439). Known from several populations on two peaks *c.* 45 km apart. Both are within State Forest.

*Etymology.* The Latin *scabridus* (scabrid) refers to the leaves.

*Affinities.* This is related to *C. huegelii* Schauer and *C. montanus* but may be readily recognised by the scabrid leaves.

### Acknowledgments

Staff of the Western Australian Herbarium gave cheerful assistance over a number of years. Staff of the National Herbarium of Victoria supplied scanned images of type material there. I studied relevant material at the Royal Botanic Gardens, Kew, the Natural History Museum, South Kensington, and other European herbaria while on duty as Australian Botanical Liaison Officer at Kew in 2004–05. In his usual inimitable way, Paul Wilson discussed various nomenclatural matters. Dick Brummitt (RBG Kew) and Ted Oliver (Stellenbosch) were enthusiastic companions on our ‘*Calothamnus* crawl’ in 2004.

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Figure 7. *Calothamnus scabridus*. Holotype, north-west of Denmark, A.R. Annels & R.W. Hearn 5537 (PERTH 04247531). Scale bar = 5 cm.



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### Note added in proof

Edwards *et al.* (2010) have foreshadowed the merger of all nine genera (including *Calothamnus*) of the tribe Melaleuceae into a single genus, *Melaleuca* L., because their molecular analysis of species from all genera implies that *Melaleuca* is not monophyletic. They prefer merging these genera to splitting *Melaleuca* into ‘multiple genera’ because ‘it is desirable to avoid generation of many new genera with few representatives’. This view of small genera is their personal one and has no scientific basis. From the early years of classifying the Australian flora we have managed perfectly well with small genera—there are now hundreds of them. The authors’ use of ‘multiple’ and ‘many’ may be misleading, since an examination of their cladograms indicates that number of new genera (additional to those currently recognised) might be just eight or nine. They say that ‘current species-poor genera may retain recognition at the subgeneric level.’ If they are recognisable within the tribe Melaleuceae, why not call them genera? What is their argument for accepting subgenera with few species but not genera? Regarding *Calothamnus*, their study included one species (out of 41), using an independently supplied DNA sample for which the determination of the voucher was not checked. All the cladograms in their paper have unresolved nodes that should be investigated further, and they have not undertaken detailed morphological analyses for novel characters and states that would differentiate groups that could be recognised at generic rank. Their paper provides very useful data on the relationships between these genera, and groups within *Melaleuca*, but it does not provide a convincing basis for merging them. Using standard keys, we have been running down specimens to the currently-named genera for over 150 years (except *Petraeomyrtus*, named in 1999). *Calothamnus* is an easily recognisable genus that should be maintained.

### References

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## A taxonomic revision of the Western Australian endemic species *Kennedia coccinea* (Fabaceae)

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### Abstract

Lally, T.R. A taxonomic revision of the Western Australian endemic species *Kennedia coccinea* (Fabaceae). *Nuytsia* 20: 201–215 (2010). Two new subspecies are described in *Kennedia coccinea*; *K. coccinea* subsp. *esotera* Lally and *K. coccinea* subsp. *calcaria* Lally. Distribution maps are provided for all the subspecies, and photographs of the type specimens for the new subspecies.

### Introduction

As part of a revision of the subtribe Kennediinae (Phaseoleae, Fabaceae), several preliminary papers are being prepared. The genus *Kennedia* Vent., the initial focus of this revision, comprises 16 known taxa, 13 of which occur in south-west Western Australia. Of these 13 taxa, *Kennedia coccinea* (Curtis) Vent. is one of the more widespread, occurring throughout much of the south-west portion of the state in a range of habitats. Like many species of *Kennedia*, *K. coccinea* has a long history of cultivation, having been initially grown in Europe as a glasshouse plant in the late 1800s and early 1900s. It continues to be a popular horticultural subject today, especially in Australia (Elliot & Jones 1993, Wrigley & Fagg 2003).

Within the genus, *K. coccinea* is recognisable by its umbellate to very shortly-racemose inflorescences of few to many flowers, sometimes on a distinct peduncle. It is the only species with the wing petals longer than the keel petals, and differently coloured wing and keel petals.

*Kennedia coccinea* exhibits considerable morphological variation throughout its range, with differences in habit, vegetative and reproductive features evident between populations. Some of this variation appears to be environmentally induced or possibly ontogenetic, but certain characters (e.g. flower number, inflorescence type and stigma morphology) appear to be more stable and are also geographically correlated. Extensive field and herbarium studies by the author indicate that the recognition of additional taxa within *K. coccinea* is warranted, and the species is here considered to comprise three subspecies. The rank of subspecies has been adopted as variation in morphology is geographically and ecologically correlated, but areas of overlap and apparent intermediates between the taxa are known.

*Kennedia coccinea* has a complicated nomenclatural history, exacerbated by its popularity as a horticultural subject in the 19th century, and is the subject of a proposal to conserve the name with a conserved type (Lally & Orchard 2008). This proposal has been followed with respect to the species nomenclature used here. Should this proposal prove unsuccessful, the necessary nomenclatural adjustments will be made in the above-mentioned revision of the subtribe.

## Methods

This study is based on examination of dried herbarium specimens (flowers reconstituted where necessary) from CANB, MEL and PERTH, supplemented with extensive field observations on numerous populations throughout the range of the species. The distribution maps were created using ArcGIS Desktop Version 9.3 and show *IBRA Bioregions Version 6.1* (Department of the Environment, Water, Heritage and the Arts 2010). Electronic data for the maps were supplied by MELISR database (National Herbarium of Victoria 2010) and WAHERB database (Western Australian Herbarium 2010).

## Taxonomy

***Kennedia coccinea*** (Curtis) Vent., *Jard. Malmaison* 2: 105, t. 105 (1805) *nom. cons. prop.* *Glycine coccinea* Curtis, *Bot. Mag.* 8: t. 270 (1794); *Zichya coccinea* (Vent.) Hügel, *Bot. Arch.* 1: pl. 1, subt. 1 (1837); *Caulinia coccinea* (Vent.) F.Muell., *Fragm.* 7: 128 (1871). *Type*: not cited (*lecto* (here designated): the plate in Ventenat, *Jard. Malmaison* 2: 105, t. 105 (1805)), *typ. cons. prop.*

*Kennedia inophylla* Lindl., *Edwards's Bot. Reg.* 17, t. 1421 (1831); *Zichya inophylla* (Lindl.) Hügel, *Bot. Arch.* 1: pl. 1, subt. 3 (1837); *Caulinia inophylla* (Lindl.) Kuntze, *Revis. gen. pl.* 1: 171 (1891); *Kennedia coccinea* var. *inophylla* (Lindl.) Domin, *Věstn. Král. České Společn. Nauk, Tř. Mat.-Přír.* 2: 42 (1923). *Type*: 'This fine species appears to have been first raised from New Holland seeds in the Royal Gardens at Kew. Mr Low, in whose Nursery our drawing was made, informs us that it was received from Mr Aiton ... under the name of *Kennedya inophylla*' (*lecto* (here designated): CGE (the 4 pieces on bottom left hand side of sheet) *n.v.*, image at CANB). *Other material*: no locality, Lindley *s.n.* (probable *syntype*: K!).

*Kennedia dilatata* Cunn. ex Lindl., *Edwards's Bot. Reg.* 18, t. 1526 (1832); *Zichya dilatata* (Cunn. ex Lindl.) Pritz., *Icon. bot. index* 1181 (1855). *Type*: 'A native of south-west coast of New Holland, where its seeds were gathered by Baxter. Our drawing was made in Mr Knights Nursery in April last.' (*lecto* (here designated): CGE, *n.v.*, image at CANB).

*Kennedia coccinea* var. *elegans* Paxton, *Paxton's Mag. Bot.* 2: 99, pl. 186 (1835). *Type*: not cited (*lecto* (here designated): the plate, *Paxton's Mag. Bot.* 2: 99, pl. 186 (1835)).

*Zichya tricolor* Lindl., *Edwards's Bot. Reg.* 25, t. 52 (1839). *Type*: 'The plant now figured was sent by Mr Young, ... of Milford near Godalming.' (*lecto* (here designated): CGE, *n.v.*, image at CANB).

*Zichya angustifolia* Lindl., *Edwards's Bot. Reg.* 25, subt. 52 (1839); *Kennedia coccinea* var. *angustifolia* (Lindl.) Diels in Engl., *Bot. Jahrb. Syst.* 35: 273 (1904). *Type*: '... Captain Mangles, who received the specimens from Swan River.' (*lecto* (here designated): CGE, *n.v.*, image at CANB).



*Zichya pannosa* Paxton, *Paxton's Mag. Bot.* 8: 147, pl. (1841); *Kennedia pannosa* (Paxton) Daveau in Bois, *Dict. hort.* 1: 743 (1893–1899). Type: 'lately introduced by various parties from the Swan River settlement, Australia, and now cultivated in most nurseries. We procured our drawing, however, from Messrs Young, of Epsom, in May 1840.' (*lecto* (here designated): the plate, *Paxton's Mag. Bot.* 8: 147, pl. (1841)).

*Zichya villosa* Lindl., *Edwards's Bot. Reg.* 27, misc. p. 41, no. 81 (1841); *Kennedia coccinea* var. *villosa* (Lindl.) Domin, *Věstn. Král. České Společn. Nauk, Tř. Mat.-Přír.* 2: 42 (1923). Type: 'Mr Standish of Bagshot has sent specimens for examination. It is from the Swan [River].' (*lecto* (here designated): CGE, n.v., image at CANB).

*Kennedia eximia* Lindl. ex Paxton, *Paxton's Mag. Bot.* 16: 35, pl. fig. 1 (1849); *Caulinia eximia* (Lindl. ex Paxton) F.Muell., *Fragm.* 7:128 (1871). Type: '...raised by Messrs Knight and Perry, from seeds received from Swan River about four years ago, through Mr Drummond.' (*lecto* (here designated): the plate, *Paxton's Mag. Bot.* 16: 35, pl. fig. 1 (1849)).

[*Kennedia dilatata* Sweet, *Hort. brit.* 481 (1826), *nom. inval.*, *nom. nud.*]

[*Kennedia heterophylla* Sweet, *Hort. brit.* 481 (1826), *nom. inval.*, *nom. nud.*]

[*Kennedia inophylla* Sweet, *Hort. brit.* 481 (1826), *nom. inval.*, *nom. nud.*]

Twining, climbing, scrambling or prostrate *shrubs*; *stems* to 4 mm diameter, with sparse to moderately dense, appressed or spreading to ascending or erect, white and sometimes ginger hairs, to glabrescent. *Leaves* discolorous, upper surface green to dark green or grey-green, sometimes glossy, lower surface dull grey-green, petioles 6–60(–70) mm long; *leaflets* 3 or rarely 5, narrowly to broadly ovate, obovate, linear to broadly elliptic or hastate, 5–23(–40) lateral veins, with sparse to dense, appressed or spreading to ascending, white or sometimes ginger hairs on both surfaces, hairs sometimes denser and more erect on lower surface, to glabrescent on upper surface; petiolules 0.5–3(–4) mm long; terminal leaflet larger than laterals, 11–83(–140) mm long, (3–)7–55 mm wide, lateral leaflets 8–68(–100) mm long, (3–)7–41 mm wide; apex rounded or emarginate, apiculate or rarely acuminate; base cuneate or rounded; *stipules* leaf-like, reflexed at 90° or retrorsely appressed against stem, triangular to broadly triangular, 1.7–5 mm long, 1.3–3.2 mm wide, upper surface with moderately dense, spreading to ascending, white or sometimes ginger to brown hairs, lower surface glabrous; apex acute or acuminate; *stipels* rarely absent, narrowly triangular, 1–3 mm long, 0.5–1 mm wide, lower pair sometimes slightly longer than upper, with dense, appressed, white or ginger hairs; apex acute. *Inflorescences* shortly racemose or umbellate, 3–30(–40)-flowered; *peduncle* terete or sometimes more or less flattened, 60–230(–300) mm long, with sparse to moderately dense, appressed or spreading to ascending or erect, white or ginger hairs. *Flowers* 9.5–16 mm long, pedicels 1.5–10(–12) mm long, with dense, ascending or erect, white and ginger to brown hairs; *subtending bracts* caducous, leaf-like, concave, ovate, 1.5–4.5(–6) mm long, 0.4–2.5(–3) mm wide, hairs as for stipules; apex acute or acuminate, sometimes with a pair of early caducous, narrowly ovate to linear inner bracts. *Calyx* cup-shaped to more or less gibbous, 5–8(–9) mm long, including lobes 2–4 mm long, with dense, appressed to spreading, ginger or brown to dark brown hairs, occasionally with white hairs towards base, sometimes overtopped with longer, ascending to spreading, brown hairs. *Corolla* orange-pink, red and pink; *standard* asymmetric, broadly ovate to obovate, (9.5–)9.8–16 mm long, including claw 2.8–4 mm long, (7.8–)8–15 mm wide, orange-red to pink, or orange-pink or rarely entirely pink, all with yellow-green eye, margin red; apex emarginate; base cuneate or rounded,

with a single semi-circular to deltoid callus or area of thickened tissue on inner face of petal at apex of claw; *wings* narrowly obovate, 8.9–14 mm long, including claw 3–4.5 mm long, 1.2–5 mm wide, intense pink; apex rounded; *keel* obovate with distinct pocket on one side, 8–11 mm long, including claw 3.6–5 mm long, 2.7–4 mm wide, red, darker at apex, whitish at base; apex rounded or shortly beaked. *Staminal* filaments to 9.8 mm long. *Ovary* with moderate dense to dense, appressed, white hairs throughout, with longer, ascending to erect, white or sometimes ginger hairs on one side; *style* bent 90° near base, glabrous or with sparse, white hairs basally, stigma capitate or appendaged, with transparent hairs mainly at base and sometimes at apex of appendage. *Pods* sessile, narrowly oblong, flattened or sometimes inflated, with thickened margins, 25–72 mm long, 4–10 mm wide, pale brown to black, with moderately dense, appressed to spreading, white or sometimes ginger hairs; apex acuminate. *Seeds* oblong-elliptic, 2.8–5(–5.2) mm long, 1.5–2.5 mm wide, mottled fawn, brown or dark brown, dull or glossy.

*Distribution and ecology.* *Kennedia coccinea* is widespread in, and endemic to, the south-west of Western Australia, extending from near Eneabba in the north, south to Augusta, inland to near York, Northam and Brookton, and east along the coast to near Israelite Bay.

This species grows in a range of habitats, from sand over limestone in coastal heath, sandy loam or loam and gravels in jarrah (*Eucalyptus marginata*), marri (*Corymbia calophylla*), karri (*E. diversicolor*) or wandoo (*E. wandoo*) forest or woodland, and lateritic gravelly sands in mallee heath.

*Kennedia coccinea* is the most floriferous species of the genus, a trait which has ensured its continued popularity as a horticultural subject since it was originally introduced to European gardens in 1803 (Elliot & Jones 1993). It can survive up to six years in cultivation, sometimes longer (Lally, pers. obs.), and as a pioneering species after soil disturbance or fire, it produces massed displays of prolific growth which persist for two or three years, before succumbing to competition (Silsbury & Brittan 1954).

*Phenology.* Flowering has been recorded from July to December, mature fruit from November to March.

#### Key to the subspecies of *Kennedia coccinea*

1. Inflorescences umbellate or rarely very shortly racemose, 3–12-flowered; plants prostrate, not scrambling or twining.....subsp. **esotera**
- 1: Inflorescence shortly racemose, (7–)13–30+-flowered; plants twining, scrambling or prostrate
2. Plants twining, scrambling or rarely prostrate; stigma capitate; apex of keel petal rounded; occurs on gravels, loams or sands in forested areas..... subsp. **coccinea**
- 2: Plants prostrate, scrambling or (very rarely) loosely twining; stigma appendaged; apex of keel petal shortly beaked; occurs on sands in coastal heath..... subsp. **calcaria**

#### *Kennedia coccinea* (Curtis) Vent. subsp. **coccinea**

*Illustrations.* Wheeler (1987) p. 277, Figure 89; Nevill (1998) p. 47; Wheeler *et al.* (2002) p. 761, cover; all as *Kennedia coccinea*.



Twining, scrambling or rarely prostrate *shrubs*. *Leaves*: petioles 13–60 mm long; *leaflets* narrowly to broadly ovate, obovate, linear-elliptic to broadly elliptic or very rarely hastate; terminal leaflet larger than laterals, 20–83(–140) mm long, (3–)7–45(–51) mm wide; lateral leaflets 15–68(–100) mm long, (3–)7–32 mm wide; apex apiculate, acute, or rarely acuminate, rounded or sometimes emarginate with apicule; *stipules* 1.7–5 mm long, 1.3–3 mm wide. *Inflorescences* shortly racemose, (7–)9–30(–40)-flowered. *Flowers* 11–15 mm long, pedicels (3–)4–10(–12) mm long; *subtending bracts* 2.2–4.5(–6) mm long, (0.9–)1.2–2.5(–3) mm wide. *Corolla*: *standard* (9.5–)12.5–16 mm long, including claw 3–4 mm long, (7.8–)8.5–15 mm wide; *wings* (9–)11–14 mm long, including claw 3–4.3 mm long, 1.2–1.9 mm wide at narrowest, (2.2–)3.2–5 mm wide at broadest; *keel* (8.7–)9–10.5 mm long, including claw 4–5 mm long, (2.9–)3.1–4 mm wide, apex rounded. *Stigma* capitate. *Pods* (31–)45–72 mm long, 4–7.5 mm wide, brown to dark brown, rarely black. *Seeds* 2.8–5 mm long. (Figure 1A)



Figure 1. Habit and habitat of the different subspecies of *Kennedia coccinea*. A – *K. coccinea* subsp. *coccinea* (T.R. Lally 1556 & I.P. Lally); B – *Kennedia coccinea* subsp. *calcaria* (The Gap Road, Torndirrup National Park, 15 Oct. 1999, T.R. Lally 1566 & I.P. Lally (CANB, MEL, PERTH)); C – *K. coccinea* subsp. *esotera* (Neds Corner Road, near Yerritup Creek crossing, 16 Oct. 1999, T.R. Lally 1581 & I.P. Lally (CANB, MEL, P, PERTH)).



*Selected specimens examined.* WESTERN AUSTRALIA: Rosedale Rd, 3.5 km NW of Chidlow, 8 Nov. 1996, *M.G. Allen* 353 (PERTH); Darling Range, 25.5 miles from Perth towards Brookton, along Brookton Hwy, 7 Oct. 1968, *E.M. Canning s.n.* (CBG); Gleneagle Forest, Kinsella Road, between Albany and Brookton Highways, near Canning Road, 21 Oct. 1981, *M.G. Corrick* 7847 (AD, MEL); Gingarup Brook, c. 6 km E of Mundijong, 4 Oct. 1965, *N.N. Donner* 1448 (AD, CANB); Northam, 1892, *A. Eaton s.n.* (MEL); Kalamunda, 19 km E of Perth, 3 Sep. 1985, *R. & M. Hamilton* 169 (CBG, MEL); Big Brook (Pemberton), Sep. 1916, *M. Koch* 2245 (MEL, NSW); 33.5 km along Hassell Hwy from Bakers Junction towards Jerramungup, 15 Nov. 1995, *T.R. Lally* 895 & *B.J. Lepschi* (AD, PERTH); 3.7 km NW of South Western Hwy on Argyle Rd/Hurst Rd, c. 8.5 km NW of Donnybrook, 18 Oct. 1996, *T.R. Lally* 1259 & *B.J. Lepschi* (BRI, CANB, MEL, PERTH); c. 20-30 metres S of corner of Bushby Rd and Caves Rd, W of Karridale, 13 Oct. 1999, *T.R. Lally* 1542 & *I.P. Lally* (CANB, PERTH); 15.3 km S of Northcliffe towards Windy Harbour, 14 Oct. 1999, *T.R. Lally* 1556 & *I.P. Lally* (CANB, K, MEL, PERTH); Napier River crossing on Chester Pass Rd, 15 Oct. 1999, *T.R. Lally* 1572A & *I.P. Lally* (CANB, K, L, MEL, PERTH); 12.2 km from corner of Nanga Brook Rd and Coffs Rd, c. 5 km SSE of Dwellingup on Nanga Rd, 18 Oct. 1999, *T.R. Lally* 1604A & *I.P. Lally* (CANB, E, MEL, NY, PERTH); outskirts of Manjimup, 7 Jan. 2000, *T.R. Lally* 1645 & *N.G. Lally* (CANB, K, PERTH); Muirilup Conservation Park, 13 km from Northcliffe, 7 Jan. 2000, *T.R. Lally* 1650 & *N.G. Lally* (CANB, BISH, E, PERTH); 0.6 km S of Wooroloo on Government Rd, 12 Jan. 2000, *T.R. Lally* 1667 & *N.G. Lally* (CANB, MEL, PERTH); Carroll Road, 11.8 km E from Waroona Town Hall, 23 Oct. 1985, *L. Nunn* 440 (CANB, PERTH); Cape Leeuwin, on east slope, 7 Sep. 1971, *S. Paust* 193 (PERTH); 1 km N of Yarloop, South Western Hwy, 12 Oct. 1985, *J.H. Ross* 2955 (CBG, HO, MEL, PERTH); Porongorup National Park, track to Castle Rock, 15 Sep. 1983, *J. Taylor* 1819 & *P. Ollerenshaw* (CBG, MO, PERTH); Walpole-Nornalup National Park, near Circular Pool, 23 Sep. 1992, *J.R. Wheeler* 3277 (PERTH); 7 km E of Mt Barker, 19 Sep. 1964, *P.G. Wilson* 3348 (AD, PERTH).

*Distribution and habitat.* Widespread from Northam, south to Augusta and east to near Albany (Figure 2). There are several old (late 1800s) records from Port Gregory, near Geraldton, and also from Bremer River, Esperance and east of Esperance. The habitats at these localities are unusual for subsp. *coccinea*, and as there are no recent collections of this taxon from these areas, these localities are considered doubtful. *Kennedia coccinea* subsp. *coccinea* occurs in sands, gravels or loams associated with eucalypt forests and shrublands.

*Conservation status.* This taxon has a wide distribution in the south-west, and is well conserved in several National Parks and Conservation Parks. It is locally common in suitable habitat and is not considered to require a conservation listing.

*Affinities.* This subspecies is distinguished from subsp. *esotera* by its twining habit, many-flowered, shortly racemose inflorescences, capitate stigmas, and rounded keel petal apices. The leaves in this taxon are also generally larger, darker green and thinner-textured than in subsp. *esotera* and subsp. *calcaria*. Populations of subsp. *coccinea* east of the Darling Scarp, between Brookton and Mount Barker, may approach subsp. *esotera*, in their smaller, obovate leaves and sometimes prostrate habit. These populations differ from subsp. *esotera* by having the many-flowered, shortly racemose inflorescences typical of subsp. *coccinea*. Post-fire or other disturbance regrowth of subsp. *coccinea* could be confused with subsp. *calcaria*, as both share a prostrate habit, and coarsely textured and sometimes densely hairy leaves. However, subsp. *coccinea* can be distinguished in these instances by its capitate stigmas (appendaged stigmas in subsp. *calcaria*), rounded keel petal apex (shortly beaked in subsp. *calcaria*), narrower mature pods (4–7.5 mm wide versus 7–10 mm wide in subsp. *calcaria*) and usually brown to dark brown pods (black in subsp. *calcaria*).

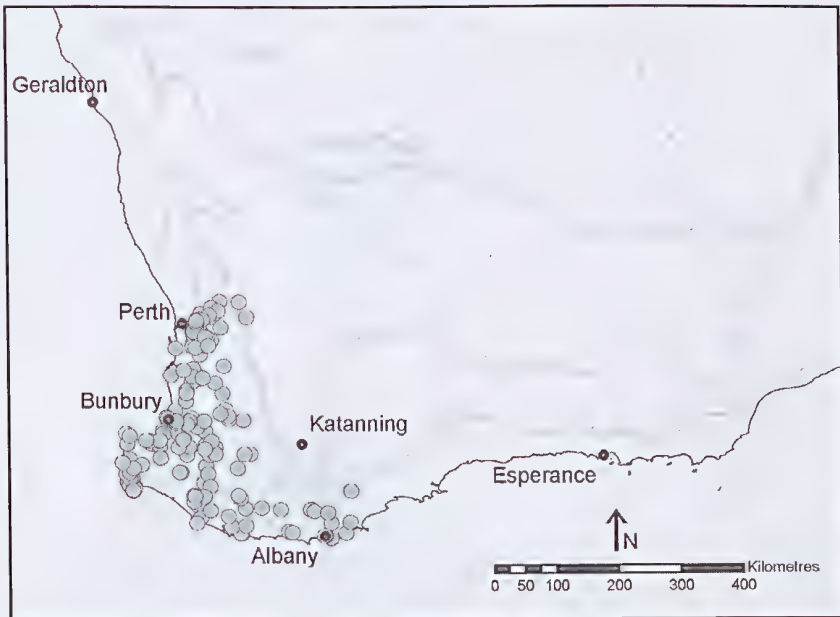


Figure 2. Distribution of *Kennedia coccinea* subsp. *coccinea* in Western Australia.

*Notes.* Unusual populations of this subspecies occur at Karridale near Augusta (represented by *T.R. Lally* 1540 & *I.P. Lally* (AUA, CANB, E, K, L, MO, NY, PERTH) and *A. Strid* 21392 (PERTH)). Plants in these populations exhibit most features of subsp. *coccinea* (twining habit and thin-textured, dark green leaves), and occur in eucalypt forest, typical habitat for this taxon. However, stigmas in plants from this population are appendaged, a character otherwise exhibited by subsp. *calcaria* and subsp. *esotera*. These plants are included in subsp. *coccinea* on the basis of vegetative characters and habitat. A population south-south-east of Dwellingup (represented by *T.R. Lally* 1604A & *I.P. Lally*) has the standard petal all pink, as opposed to the more usual orange with pink edges, but is otherwise typical for this taxon.

Additional variation in leaf shape, indumentum and texture is also evident in subsp. *coccinea*, however this variation is not sufficiently discrete or constant to allow for the recognition of additional taxa. Some geographical correlation with this variation is apparent, but this is not absolute, and all forms can occur within the same population, especially for plants in vigorous post-disturbance growth phases. In more established populations the following forms are recognisable.

*Perth area form:* Leaves obovate, coarsely textured, with < 8 obvious lateral veins, leaf apex emarginate, apiculate. Leaves with moderately dense to dense, erect hairs on both surfaces, or less commonly the hairs sparse and appressed, to glabrescent on upper surface. Pods brown to dark brown, more or less flat. Occurs mostly in the Perth area and along the Darling Scarp north to Northam and south to Pinjarra. Representative specimens are *T.R. Lally* 1263 & *B.J. Lepschi* (BRI, CANB), *T.R. Lally* 1610 & *I.P. Lally* (AD, AUA, CANB, K, MEL, MO, MU, P, PERTH, US, W) and *A. Travers* 6 (CANB, PERTH).

*Southern form:* Leaves narrowly ovate to ovate, thinly textured, with 7–20 more or less obscure lateral veins, leaf apex acute. Leaves with sparse to moderately dense, appressed to ascending, or less

commonly erect hairs on both surfaces, to glabrescent. Pods dark brown to sometimes black, somewhat inflated. Throughout the range of the subspecies, but infrequent in the Perth area. Representative specimens are *L. Nunn* 440, *R. Pullen* 9872 (CANB) and *P.G. Wilson* 3348.

*Narrow-leaved form:* Leaves linear-elliptic to narrowly ovate, thinly textured, with 15–40 more or less obscure lateral veins, leaf apex acute. Leaves with sparse to moderately dense, usually appressed, sometimes ascending hairs on both surfaces. Pods as for Southern form. Sporadically distributed throughout the range of the subspecies, apparently uncommon, and is most likely to occur in the cooler, denser forests in the south-west part of the subspecies' range. Representative specimens are *T.R. Lally* 1540 & *I.P. Lally* (AUA, CANB, E, K, L, MO, NY, PERTH), *T.R. Lally* 1554 & *I.P. Lally* (CANB, PERTH) and *T.R. Lally* 1556 & *I.P. Lally*.

***Kennedia coccinea*** (Curtis) Vent. subsp. ***calcaria*** Lally, subsp. nov.

Affinis subsp. *coccinea*, sed habitu prostrato, stigmatibus appendiculatis et carina petalo apice breviter rostrato, differt.

*Typus:* carpark at end of Salmon Holes Road, from Frenchman Bay Road, Torndirrup National Park, south of Albany, Western Australia, 15 October 1999, *T.R. Lally* 1568 & *I.P. Lally* (holo: CANB 680794; iso: AD, K, MEL, MO, NSW, NY, PERTH).

*Zichya sericea* Benth. in Endl. *et al.*, *Enum. pl.* 40, sub. 2 (Apr. 1837), *nom. illeg.* (non Hügel (Feb. 1837)). *Type:* Nov. Holl., *Ferd. Bauer s.n.* (holo: W0006143).

*Kennedia coccinea* subsp. Coastal (T.R. & I.P. Lally TRL 1568) Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 22 February 2010]

*Illustrations.* Craig (1995) p. 46, pl. 136; Corrick & Fuhrer (1996) p. 66, pl. 172; both as *Kennedia coccinea*.

Prostrate, scrambling or (very rarely) loosely twining *shrubs*. *Leaves:* petioles 20–60 mm long; *leaflets* broadly ovate, broadly elliptic or occasionally hastate; terminal leaflet larger than laterals, 35–87 mm long, 20–55 mm wide; lateral leaflets 29–65 mm long, 15–41 mm wide; apex apiculate, rounded, sometimes emarginate or rarely truncate (all with apicule); *stipules* 3.5–4.3 mm long, 2.2–3.2 mm wide. *Inflorescence* shortly racemose, 13–30-flowered. *Flowers* 12–16 mm long, pedicels 2.5–6.5(–8) mm long; *subtending bracts* 3–3.5 mm long, 0.4–1.7 mm wide. *Corolla:* *standard* 13–16 mm long, including claw 3–4 mm long, 10–15 mm wide; *wings* 11.2–13.5 mm long, including claw 3.3–4.5 mm long, 1.3–2.2 mm wide at narrowest, 3.8–4.8 mm wide at broadest; *keel* 9–11 mm long, including claw 4–5 mm long, 2.8–3.5 mm wide, apex shortly beaked. *Stigma* appendaged. *Pod* 50–68 mm long, 7–10 mm wide, black. *Seeds* (3.8–)4–4.9(–5.2) mm long. (Figures 1B, 3)

*Selected specimens examined.* WESTERN AUSTRALIA: Boat Harbour, Denmark, 21 Oct. 1983, *P. Armstrong* 83/11 (PERTH); 6 miles inland of Cervantes, 17 Sep. 1976, *J.S. Beard* 7842 (NSW, PERTH); Rockingham Rd, 21 Sep. 1957, *A.M. Baird s.n.* (PERTH); no 2 Track, Southern Beekeepers Reserve, c. 6 km NE of Cervantes, 2 Sep. 1986, *A.H. Burbidge* 4010 (CANB, PERTH); c. 12.2 miles from Young's Siding toward Albany along coast (lower) road, 12 Oct. 1968, *E.M. Canning* WA/68 6325 (CBG, NSW); Boggy Lake, Nov. 1958, *D. Churchill* 169 (PERTH); near Windy Harbour, Sep. 1967, *C.H. Gittins* 1747 (NSW); Frenchman's Bay, Albany, 26 Oct. 1985, *N. Hoyle* 1336 (PERTH);





Figure 3. Holotype of *Kennedia coccinea* subsp. *calcaria* Lally (CANB 680794).

Deep River, Dec. 1912, *S.W. Jackson s.n.* (NSW, PERTH); golf course, Augusta, 1 Oct. 1982, *G.J. Keighery* 5358 (PERTH); Ludlow Rd, Tuart Forest National Park, W of Capel, 15 Sep. 1994, *G.J. Keighery* 13584 (PERTH); 0.4 km from Frenchman Bay Rd on Salmon Holes Rd, Torndirrup National Park, 15 Oct. 1999, *T.R. Lally* 1570 & *I.P. Lally* (CANB, L, PERTH, US); Frenchman Bay Rd, c. 50 metres S of Symers Rd, 15 Oct. 1999, *T.R. Lally* 1571 & *I.P. Lally* (CANB, K, MEL, PERTH); carpark at end of Salmon Holes Rd, from Frenchman Bay Rd, Torndirrup National Park, 8 Jan. 2000, *T.R. Lally* 1657 & *N.G. Lally* (AUA, CANB, K, MEL, PERTH, US); Frenchman Bay Rd, c. 50 metres S of Symers Rd, 8 Jan. 2000, *T.R. Lally* 1658 & *N.G. Lally* (AD, CANB, K, MEL, PERTH, US); 13 km from Albany along road to Frenchman Bay, 1 Sep. 1986, *P.S. Short* 2619, *M. Amerena* & *B.A. Fuhrer* (CANB, MEL); 3 miles E of Jurien Bay, 1 Sep. 1966, *R.V. Smith* 66/173 (CBG, HO, MEL); Walpole-Nornalup National Park, Hush Hush Beach, 27 Oct. 1992, *J.R. Wheeler* 3353 (PERTH); Torbay Inlet, on east headland, 12 Oct. 1968, *J.W. Wrigley* WA/68 4509 (CBG).

**Distribution and habitat.** Extends along the coast from Jurien Bay in the north, and to Albany in the south (Figure 4). Occurs in sand over limestone in coastal heath vegetation.

**Conservation status.** This taxon is distributed along coastal areas in the south-west, and is well conserved in several National Parks. It is locally common in suitable habitat and is not considered to require a conservation listing.

**Affinities.** Similar to subsp. *coccinea*, sharing the densely-flowered shortly racemose inflorescences, but differing chiefly by its prostrate habit, appendaged stigma, and shortly beaked keel petal apex. The leaves in subsp. *calcaria* are also generally coarsely textured, dull grey-green, and the vegetative parts are covered with moderately dense to dense, erect, white or ginger hairs, giving the plant a silvery or velvety appearance. Although post-disturbance regrowth populations of subsp. *coccinea* can also

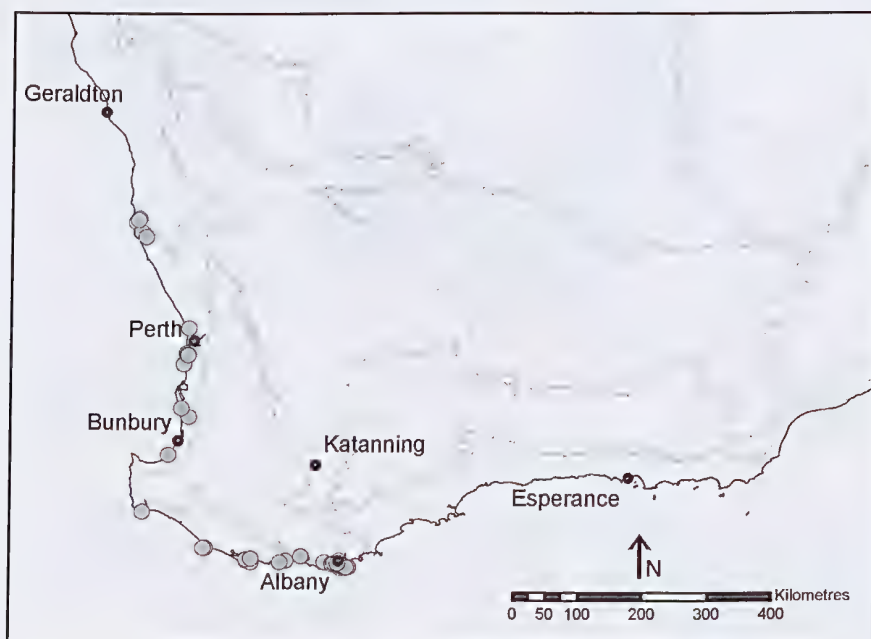


Figure 4. Distribution of *Kennedia coccinea* subsp. *calcaria* in Western Australia.

have coarsely textured, hairy leaves, they are darker green, and the vegetative parts are less robust. *Kennedia coccinea* subsp. *calcaria* may also be confused with subsp. *esotera*, with which it shares a prostrate habit, appendaged stigma and shortly beaked keel petal apex, but subsp. *esotera* differs in its 3–12-flowered umbellate inflorescences (13–30-flowered and shortly racemose in subsp. *calcaria*), shorter flowers (9.5–14 mm long versus 12–16 mm long) and less coarse habit.

*Etymology.* The subspecies name is derived from the Latin *calcarius* (of lime), in reference to the occurrence of this subspecies on coastal limestone.

*Notes.* Of the populations of this taxon north of Perth, there are several in the Cervantes and Jurien Bay area (represented by *J.S. Beard* 7842, *A.H. Burbidge* 4010 and *R.V. Smith* 66/173) with the robust prostrate habit of subsp. *calcaria*, but plants in these populations lack the appendaged stigma and beaked keel apex typical of this taxon. These populations are included here under subsp. *calcaria* as they exhibit the typical robust, prostrate habit of this taxon, and they also occupy typical habitat for subsp. *calcaria*. Several collections from the Albany area included here (represented by *E.M. Canning* 68/6325, *D. Churchill* 169, *T.R. Lally* 1571 & *I.P. Lally*) exhibit most of the typical features of this subspecies, but plants are less robust, and are also twining on nearby vegetation, a feature more typical of subsp. *coccinea*. These populations occur in forested areas close to the coast, and the more closed vegetation may be an influencing factor for the expression of these characters.

***Kennedia coccinea*** (Curtis) Vent. subsp. *esotera* Lally, *subsp. nov.*

Affinis subsp. *coccinea*, sed habitu prostrato et inflorescentiis umbelliformis, paucifloribus, differt.

*Typus:* 11 km north of Boxwood Hill along Highway 1 towards Jerramungup, Western Australia, 22 September 1979, *M.D. Crisp* 6081, *J. Taylor* & *R. Jackson* (*holo:* CANB CBG 7908370; *iso:* AD *n.v.*, NSW *n.v.*, PERTH 02871580)

*Kennedia coccinea* subsp. Inland (T.R. & I.P. Lally TRL 1584) Western Australian Herbarium, in *FloraBase*, <http://florabase.dec.wa.gov.au> [accessed 22 February 2010]

Prostrate *shrubs*. *Leaves:* petioles 6–25 mm long; *leaflets* hastate, obovate or rarely broadly ovate; terminal leaflet larger than laterals 11–50 mm long, 10–32 mm wide, lateral leaflets 8–40 mm long, 7–24 mm wide, apex rounded or emarginate, apiculate; *stipules* 1.8–3.3 mm long, 1.4–2.8 mm wide. *Inflorescences* umbellate or rarely very shortly racemose, 3–12-flowered. *Flowers* 9.5–14 mm long, pedicels 1.5–5 mm long; *subtending bracts* 1.5–2.5 mm long, 0.6–1.2 mm wide. *Corolla:* *standard* 9.8–13 mm long, including claw 2.8–4 mm long, 8.5–12 mm wide; *wings* 9.5–12 mm long, including claw 3.5–4.5 mm long, 1.2–1.8 mm wide at narrowest, 3.2–4.8 mm wide at broadest; *keel* 8.2–9.5 mm long, including claw 3.6–5 mm long, 2.5–3.2 mm wide, apex beaked. *Stigma* appendaged, less commonly capitate. *Pods* (immature) 25–55 mm long, 6–9 mm wide, black. *Seeds* (immature) 3.3–3.7 mm long. (Figures 1C, 5)

*Selected specimens examined.* WESTERN AUSTRALIA: Merivale Rd, 8 km W of Mt Merivale, c. 13 km E of Esperance, 19 Aug. 1995, *W.R. Archer* 1908953 (MEL, PERTH); Mt Ragged, 26 Sep. 1995, *S. Barrett* 510 (PERTH); South Stirling Rubbish Reserve, Chillinup Rd, Albany, 28 Aug. 1985, *E.J. Croxford* 4201 (PERTH); 156 mile peg, Eneabba Rd [c. 27 km S of Eneabba], 22 Sep. 1972, *H. Demarz* 3935 (PERTH); c. 8 km NW of Young River crossing on Ravensthorpe–Esperance



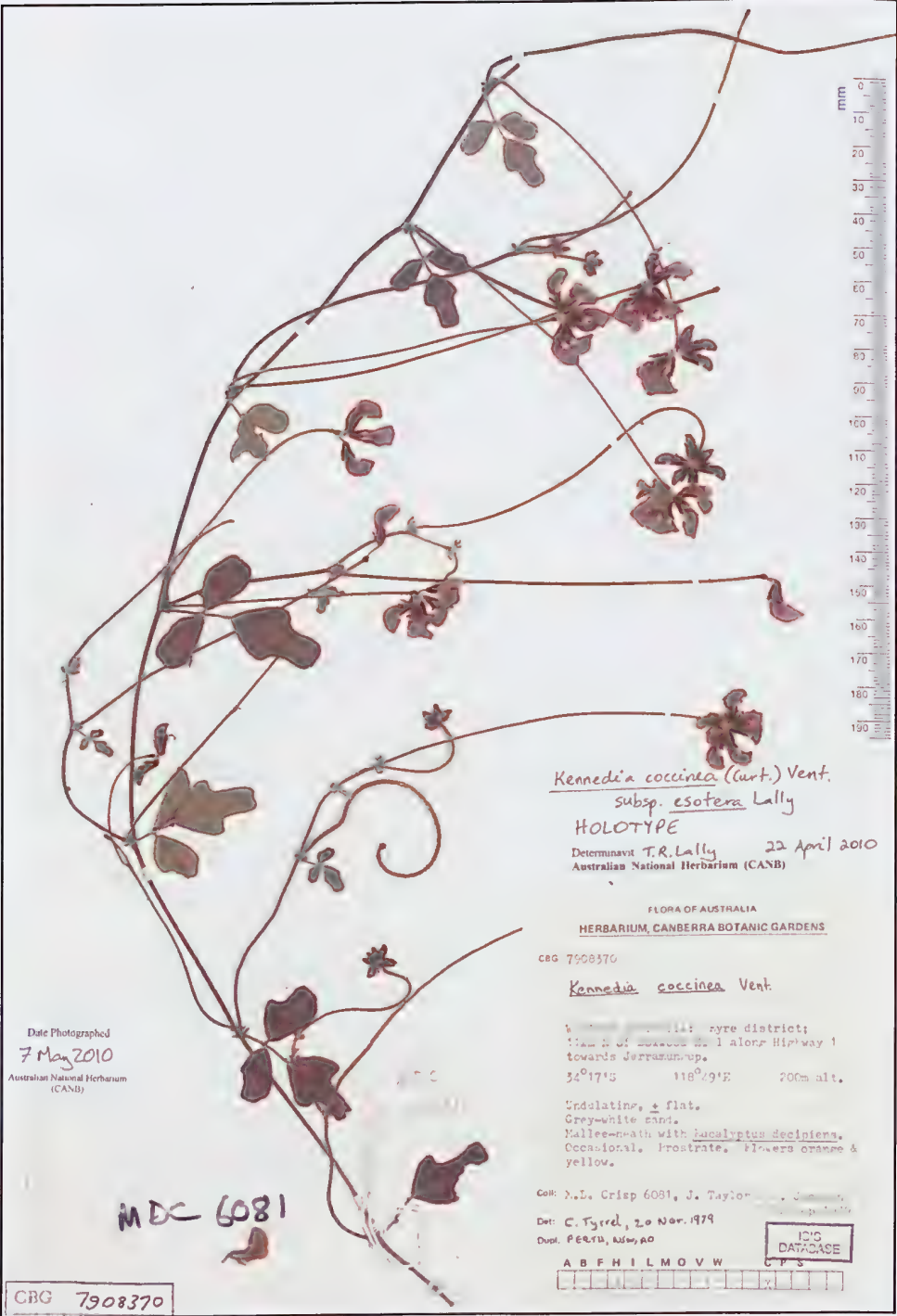


Figure 5. Holotype of *Kennedia coccinea* subsp. *esotera* Lally (CBG 7908370).

main road, 26 Sep. 1968, *N.N. Donner* 2779 (AD, CANB, PERTH); Fitzgerald River National Park, c. 23 km along the Rabbit Proof Fence no. 2, SE of the turnoff from the Jerramungup-Ravensthorpe Rd, 7 Sep. 1971, *Hj. Eichler* 21053 (AD, CANB); junction of York and Northam Rds, 14 Oct. 1956, *J.W. Green* 523 (PERTH); 20 km ENE of Collie Cemetery, 20 Aug. 1997, *A. Gundry* 354 (PERTH); c. 10 km by road NNE of Kalgan River crossing by Chester Pass Rd, 14 Sep. 1977, *E.N.S. Jackson* 3324 (AD, CBG); Yerritup Creek crossing on Neds Corner Rd, c. 2.5 km N of South Coast Highway, 16 Oct. 1999, *T.R. Lally* 1580 & *I.P. Lally* (CANB, PERTH); 4.2 km N of Jonegatup Rd on Farmers Rd, c. 10 km NE of Munglinup, 29 Oct. 1997, *B.J. Lepschi* 3800 & *B.A. Fuhrer* (AD, CANB, PERTH); Cape Arid, *s. dat.*, *F. Mueller s.n.* (MEL); Kojonup, 24 Sep. 1953, *N. Rainbow s.n.* (NSW); Cape Le Grand National Park, E of Esperance, 22 Oct. 1969, *R.D. Royce* 8789 (CANB, PERTH); 20 km from Esperance towards Gibson, 10 Sep. 1983, *J.M. Taylor* 1620 & *P. Ollerenshaw* (AD, CBG, MEL, PERTH); Two Peoples Bay, 10 Sep. 1971, *S. Paust* 449 (PERTH); near Porongurup township, N of Porongurup Range, 29 Sep. 1966, *P.G. Wilson* 4270 (CANB, PERTH); 45 km W of Israelite Bay, 1 Oct. 1968, *P.G. Wilson* 8153 (CANB, PERTH).

*Distribution and habitat.* Scattered from just south of Eneabba, inland through the wheatbelt to Albany, including the Stirling Range, and east to near Israelite Bay (Figure 6). Compared to the other subspecies of *K. coccinea*, this taxon appears to be relatively uncommon, with few recent (post-1980) collections. Extensive field work by the author during 1999 and 2000 failed to re-locate many populations based on older collections. *Kennedia coccinea* subsp. *esotera* occurs in sand, loam or gravel, in open eucalypt forest, mallee-heath or scrub. Many collections have been made from open, disturbed sites such as roadsides.

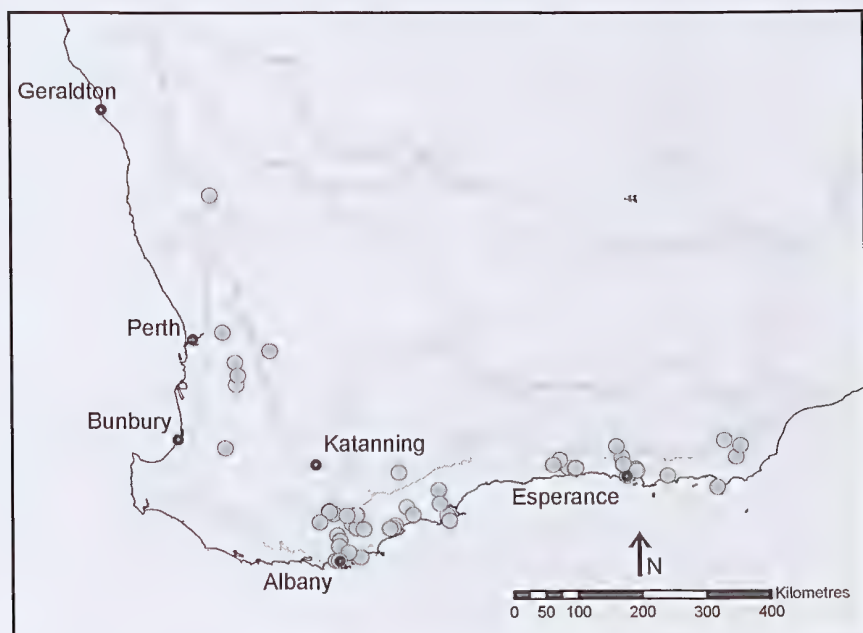


Figure 6. Distribution of *Kennedia coccinea* subsp. *esotera* in Western Australia.

*Conservation status.* This taxon has a scattered distribution in the south-west, and is well conserved in several National Parks. Although no conservation coding is recommended here, its status should be re-examined in the future as it is not abundant at any of its currently known populations.

*Affinities.* *Kennedia coccinea* subsp. *esotera* shares a prostrate habit, appendaged stigma and shortly beaked keel petal apex with subsp. *calcaria*, but differs in its 3–12-flowered umbellate inflorescences (13–30-flowered and shortly racemose in subsp. *calcaria*), generally shorter flowers (9.5–14 mm long versus 12–16 mm long in subsp. *calcaria*) and less robust habit. *Kennedia coccinea* subsp. *coccinea* differs from subsp. *esotera* by its strongly twining habit, many-flowered, shortly racemose inflorescences, capitate stigma, rounded keel petal apex, and generally dark green, thin-textured leaves.

*Etymology.* The subspecies name is derived from the Greek *esoteros* (inner), in reference to the distribution of this subspecies, occurring inland.

*Notes.* As with subsp. *coccinea*, some additional morphological variation is evident in subsp. *esotera*, but this variation is not sufficiently discrete to allow for the recognition of any additional taxa.

*Eastern form:* Leaves usually hastate, less often obovate or elliptic, flowers 10–14 mm long, stigma appendaged, keel petal apex shortly beaked. Occurs in the Stirling and Porongurup Ranges, eastwards to Israelite Bay. Representative specimens are *M.D. Crisp* 6081, *J. Taylor & R. Jackson, S.J. Forbes* 1107 (CANB, MEL) and *T.R. Lally* 1581 & *I.P. Lally* (CANB, MEL, P, PERTH).

*Northern form:* Leaves obovate, flowers 9.5–11(–13) mm long, stigma appendaged or capitate, keel petal apex shortly beaked or rounded. Occurs from the Eneabba area southwards to Albany, although known only from a few widely scattered collections, many from vague localities which could not be re-located. Mature plants of this form tend to be rather unobtrusive, which may account for the lack of recent collections. Representative specimens are *E.M. Canning* WA/68 3715 (CBG), *J.W. Green* 523 and *N. Hoyle* 1437 (CANB, PERTH).

### Names of uncertain application

No type material has been located for the following names, but the descriptions indicate that they are likely referable to *Kennedia coccinea* sens. lat.

*Kennedia sericea* G.Don, *Gen. hist.* 2: 343 (1832). Type: ‘Native of New Holland...Clt. 1823.’

*Zichya molly* Hügel ex Benth. in Hügel, *Bot. Arch.* 1: pl. 1 (Feb. 1837); *Kennedia coccinea* var. *molly* (Hügel ex Benth.) Domin, *Věstn. Král. České Společn. Nauk, Tř. Mat.-Přír.* 2: 42 (1923). Type: ‘...welcher von dem Herausgeber am Schwanenflusse auf der Südwestküste von Neu Holland entdeckt...’

*Zichya sericea* Hügel, *Bot. Arch.* 1: pl. 1, subt. 2 (Feb. 1837); *Kennedia coccinea* var. *sericea* Domin, *Věstn. Král. České Společn. Nauk, Tř. Mat.-Přír.* 1921–22: 42 (1923). Type: unknown.



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## Re-evaluation of *Ptilotus polystachyus* sens. lat. (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*

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### Abstract

Davis, R.W. & Butcher, R. Re-evaluation of *Ptilotus polystachyus* sens. lat. (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*. *Nuytsia* 20: 217–227 (2010). This paper evaluated infraspecific taxa in *Ptilotus polystachyus* (Gaudich.) F.Muell. using morphometric analysis. We conclude that var. *arthrotrichus* Benl should not be regarded as a distinct variety from var. *polystachyus* and that var. *longistachyus* (W.Fitzg.) Benl and var. *pullenii* (Benl) Benl should be merged into a single taxon and elevated in rank to species. The new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher is erected for this taxon. With these changes, *P. polystachyus* is now regarded as a widespread and variable species without infraspecific taxa. Revised descriptions are presented for these two species.

### Introduction

This paper is a part of a series dealing with appropriate ranks for Western Australian infraspecific taxa within *Ptilotus* R.Br., in preparation for the *Flora of Australia* treatment of Amaranthaceae. The paper examines the differences among the current varieties of *P. polystachyus* (Gaudich.) F.Muell. sens. lat. using morphometric analysis, and establishes the new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher.

*Ptilotus polystachyus* is a widely distributed taxon found in all mainland States and the Northern Territory. Benl (1983) recognised four varieties: var. *polystachyus*, var. *arthrotrichus* Benl, var. *longistachyus* (W.Fitzg.) Benl and var. *pullenii* (Benl) Benl. Within var. *polystachyus* and var. *arthrotrichus* he distinguished four formae: f. *polystachyus* and f. *rubriflorus* (J.M.Black) Benl, and f. *arthrotrichus* Benl and f. *ruber* Benl, respectively.

*Ptilotus longistachyus* W.Fitzg. was demoted to a variety of *P. polystachyus* by Benl (1960) after he examined specimens (see Benl 1983: 271; none held at PERTH) that he regarded as intermediate between the species. *Ptilotus pullenii* Benl was demoted to a variety of *P. polystachyus* by Benl (1983) after he determined that the floral morphology of *P. pullenii* was very similar to that of var. *longistachyus*. Although he noted that var. *arthrotrichus* was more closely related to var. *polystachyus* than were var. *longistachyus* and var. *pullenii*, Benl (1983: 274) asserted that the latter two taxa could not be recognised at a higher taxonomic rank, citing a collection of each that he felt was intermediate with var. *polystachyus* in floral characters.



In his synopsis of *Ptilotus* in eastern Australia, Bean (2008: 245) stated that '[m]ost if not all of these varieties and formae are of no taxonomic consequence' and synonymised var. *arthrotrichus*, f. *arthrotrichus*, f. *rubriflorum* and f. *ruber* under a broadly circumscribed *P. polystachyus*. Regarding var. *longistachyus* and var. *pullenii*, Bean (2008) noted that the former may be worthy of its varietal rank due to its short tepals, but did not mention the latter. The Western Australian Herbarium (PERTH) has maintained all four varieties of *P. polystachyus* on the *Census of Western Australian Plants* (see Western Australian Herbarium 1998–) pending the completion of taxonomic studies on the western taxa of *Ptilotus*.

In support of Bean (2008), it is evident from examination of all PERTH specimens of *P. polystachyus* that var. *polystachyus* and var. *arthrotrichus* are very similar in overall morphology and these taxa share an oblique staminal cup bearing stiff short hairs, and a gibbous ovary (Figure 4A in Benl 1983). Comparatively, var. *longistachyus* and var. *pullenii* clearly differ from these in having a (sub-) symmetrical staminal cup bearing long, silky hairs, and a non-gibbous ovary (Figure 4B in Benl 1983). As substantially more collections of all these varieties are available for study now than were available to Benl, it is possible to critically re-examine the boundaries between the taxa as well as the characters used for their distinction. To this end a morphometric analysis of *P. polystachyus sens. lat.* has been undertaken.

### Methods

Nine characters (four continuous quantitative characters and five qualitative binary/multistate characters; Table 1) were measured for 34 specimens of *Ptilotus polystachyus* held at PERTH and on loan from CANB. These comprised 16 specimens of var. *polystachyus*, 12 specimens of var. *arthrotrichus* (including the holotype, C.A. Gardner 6323), six specimens of var. *longistachyus* (including a syntype, W.V. Fitzgerald 1080), two specimens of var. *pullenii* (including the holotype, Hj. Eichler 22488) and two specimens identified only as *P. polystachyus* but having the morphology of var. *longistachyus* and var. *pullenii*. Specimens of var. *polystachyus* were selected to encompass the geographic range of this species across Western Australia and the range of morphological variation observed.

Five measurements were made for each character with the mean used in morphometric analysis. Indumentum of the ovary and style was assessed using a dissecting microscope and subjectively coded to reflect the variation observed. Some characters used by Benl (1983) to distinguish between the varieties were not used in the analysis as they were found to vary continuously across all specimens and could not be scored as discrete characters. These included leaf shape, spike width, apex shape and colour at maturity, indumentum of the vegetative parts, and bract shape and indumentum. Characters found by the first author to be reliable for discriminating taxa within *Ptilotus* (i.e. tepal, bract, bracteole and style length) supplemented the data set; however, style length was excluded from the analysis as it was strongly correlated to tepal length. A character not previously recorded for *P. polystachyus sens. lat.* and included in the analysis concerns the morphology of the pedicel and its apex (Table 1). All characters were measured from herbarium specimens.

Where available, specimens cited by Benl (1983) as displaying intermediate morphology between varieties (e.g. A.C. Beauglehole 54017, var. *longistachyus* tending towards var. *polystachyus*) or as clearly illustrating the discriminating characters between varieties (e.g. A.S. George 12813, var. *longistachyus*; D. Symon 5271, var. *pullenii*) were included in the data set. Voucher specimen details are presented in Table 2.

**Table 1.** Characters used in the morphometric analysis of *Ptilotus polystachyus* and character codes used in the NMDS ordination.

Quantitative characters		Code
1.	Bract length (mm):	BL
2.	Bracteole length (mm):	BrL
3.	Tepal length (mm):	TL
4.	Pedicel length (mm):	PL
Qualitative characters		
1.	Ovary summit indumentum: 1 – glabrous, 2 – sparsely hairy, 3 – densely hairy	IOS
2.	Style base indumentum: 0 – glabrous, 1 – hairy	ISB
3.	Ovary shape: 0 – gibbous, 1 – not gibbous	OS
4.	Staminal cup shape: 0 – oblique, 1 – sub-symmetrical or symmetrical	SCS
5.	Pedicel morphology: 0 – slender, apical disc reduced, 1 – squat, apical disc prominent	PM

The resulting data matrix was analysed phenetically using the software package Primer 6 (v. 6.1.13) (Clarke & Gorley 2006). The Gower metric (Gower 1971) was used to create a resemblance matrix, as it is suitable for use with datasets containing a mixture of qualitative and quantitative characters (Crisp & Weston 1993; Flann *et al.* 2008). The unweighted pair-group method of arithmetic averages (UPGMA) was used to create a dendrogram of hierarchically clustered individuals from this association matrix. This matrix was also used to derive an ordination using non-metric multidimensional scaling (NMDS). The ordination was run 100 times using random starting configurations and the result having the lowest Kruskal stress value in two- and three-dimensional space retrieved. Spearman rank correlation coefficients were calculated to assess the relative contribution of each character to the ordination.

..4

Results

Cluster analysis of the *Ptilotus polystachyus* dataset identified two main groups: the first consisted of the individuals of var. *longistachyus*, var. *pullenii* and var. *indet* united at a similarity level of *c.* 90, while the second contained all of the individuals of var. *polystachyus* and var. *arthrotrichus* united at a similarity level of *c.* 75. These two groups were united at a similarity level of *c.* 40 (Figure 1).

This clear division of the samples into two groups was also dramatically recovered in the two- and three-dimensional NMDS ordinations (Figure 2A; three-dimensional ordination not shown), where the samples of vars *longistachyus*+*pullenii*+*indet* and vars *polystachyus*+*arthrotrichus* formed two tight clusters distantly separated from one another, due to the inclusion in the dataset of three qualitative characters (ovary shape, staminal cup shape, pedicel morphology) that were perfect discriminators between the pairs of varieties. Magnifying the ordination space around each cluster shows that the samples of var. *longistachyus* and var. *pullenii* (Figure 2B) and of var. *polystachyus* and var. *arthrotrichus* (Figure 2C) cannot be clearly separated from one another. Kruskal stress values for the two- and three-dimensional ordinations were equally extremely low (0.01). Characters contributing

**Table 2.** Voucher specimens used in the morphometric analysis of *Ptilopus polystachyus sens. lat.* indicating the variety each specimen was identified as at the time of analysis and the species to which it is now assigned. CANB/CBG and PERTH sheet numbers were used to label the specimens in the analysis. Specimens marked with an asterisk (\*) are types.

Variety	Species	Collector	Locality	Voucher
<i>arthrotrichus</i>	<i>polystachyus</i>	A.C. Beaglehole 59267 & E.G. Errey 2972	67 km NE of Lagrange Aboriginal Mission turnoff, Great Northern Hwy	PERTH 00340170
<i>arthrotrichus</i>	<i>polystachyus</i>	E.M. Bennett 1932	19 miles W of Langley [Langley] Bridge, Fitzroy [Crossing]	PERTH 00226734
<i>arthrotrichus</i>	<i>polystachyus</i>	N.T. Burbidge 1291	Nalgi Station, 80 Mile Beach	PERTH 00337137
<i>arthrotrichus</i>	<i>polystachyus</i>	G.W. Carr 3539 & A.C. Beaglehole 47317	E branch of Wolfe Creek, c. 60 km S of Halls Creek, Kimberley	PERTH 00337153
<i>arthrotrichus</i>	<i>polystachyus</i>	B.J. Carter 26	One Arm Point, SE tip of Dampierland	PERTH 00814318
<i>arthrotrichus</i>	<i>polystachyus</i>	C.A. Gardner 6323	N of Roebourne	* PERTH 00227633
<i>arthrotrichus</i>	<i>polystachyus</i>	K.F. Kenneally 5510	Transect through to Geegully Creek, Edgar Range, SE of Broome	PERTH 227625
<i>arthrotrichus</i>	<i>polystachyus</i>	K.F. Kenneally 5579	Edge of transect NE towards Edgar Range from D2, Edgar Range, SE Broome	PERTH 222895
<i>arthrotrichus</i>	<i>polystachyus</i>	N.F. Norris 880	31 km SW Sandfire Flat along Great Northern Hwy	PERTH 00302503, MEL
<i>arthrotrichus</i>	<i>polystachyus</i>	Y. Power 740	Camballin	PERTH 00226645
<i>arthrotrichus</i>	<i>polystachyus</i>	R. Pullen 9323	c. 80 km towards Borroolooka from Daly Waters	CANB 0263458
<i>arthrotrichus</i>	<i>polystachyus</i>	R.D. Royce 1878	E of Gregory Range along Number 1 Rabbit Proof Fence	PERTH 00227641
indet	<i>giganteus</i>	I. Cowie 4578 & J. Egan	Mataranka, Eusey National Park	CANB 0472924, DNA, M
indet	<i>giganteus</i>	I.R. Telford 7642 & J.W. Hrigley	Kakadu National Park, Obiri Rock track, 4 km NW of Alligator River crossing of Oenpelli Rd	CGB 8003022
<i>longistachyus</i>	<i>giganteus</i>	A.C. Beaglehole 54017	The Grotto, 2 km W of Great Northern Hwy, c. 30 km SSE Wyndham	PERTH 00227684, CANB
<i>longistachyus</i>	<i>giganteus</i>	W.V. Fitzgerald 1080	Between Station Ck and Isdell River	* PERTH 01558242
<i>longistachyus</i>	<i>giganteus</i>	A.S. George 12813	Near Gariyeli Ck, Prince Regent River Reserve	PERTH 227706, AD, CANB, K, MEL



<i>longistachyus</i>	<i>giganteus</i>	<i>K.F. Kennelly</i> 10119	Crocodile Creek, Yampi Peninsula, W Kimberley	PERTH 02279363
<i>longistachyus</i>	<i>giganteus</i>	<i>K.F. Kennelly</i> 11251	Above King George Falls, King George River, NE Kimberley	PERTH 02250128
<i>longistachyus</i>	<i>giganteus</i>	<i>P.G. Wilson</i> 11146	Osborne Island, Bonaparte Archipelago	PERTH 227714
<i>polystachyus</i>	<i>polystachyus</i>	<i>P.G. Armstrong</i> s.n.	900 m NW of the intersection of Mulga Rd West and Gordon Rd, Stakehill	PERTH 05944899
<i>polystachyus</i>	<i>polystachyus</i>	<i>K.J. Atkins</i> 461	Paraburdoo Mine flats	PERTH 06108172
<i>polystachyus</i>	<i>polystachyus</i>	<i>R.J. Cranfield</i> 415	Coogee, opposite South Fremantle Power Station	PERTH 00222887
<i>polystachyus</i>	<i>polystachyus</i>	<i>H.N. Foote</i> 14	East Road to Cooma Well	PERTH 02465396
<i>polystachyus</i>	<i>polystachyus</i>	<i>D.W. Goodall</i> 3065	Belele Station, (area 58) Dantthroobubba paddock	PERTH 06293964
<i>polystachyus</i>	<i>polystachyus</i>	<i>W. Greuter</i> 22562	Shark Bay, 2 km E of Monkey Mia along road to Denham	PERTH 03152472
<i>polystachyus</i>	<i>polystachyus</i>	<i>S.D. Hopper</i> 2847	Gibson Desert, NE end of Clutterbuck Hills	PERTH 00785873
<i>polystachyus</i>	<i>polystachyus</i>	<i>A.E. de Jong</i> s.n.	Gary Hwy [Gibson Desert]	PERTH 06633366
<i>polystachyus</i>	<i>polystachyus</i>	<i>R. Meissner &amp; B. Bayliss</i> 1412	Robinson Range, c. 3.35 km E of spot elevation 587m and c. 2.5 km N Mt Fraser	PERTH 07735669
<i>polystachyus</i>	<i>polystachyus</i>	<i>S. Murray</i> 292	Kulin area	PERTH 05282845, CANB
<i>polystachyus</i>	<i>polystachyus</i>	<i>R. Pickering</i> Y 42	c. 30 m NE of Pioneer Drive opposite house number 25; Yangebup	PERTH 07105029
<i>polystachyus</i>	<i>polystachyus</i>	<i>M.O. Rankin</i> 1300	80 km W of Stuart Hwy on Buchanan Hwy	CBG 7911244, DNA, K
<i>polystachyus</i>	<i>polystachyus</i>	<i>L.W. Sage</i> 1034	2.25 km S on Pipeline track off Wellard Rd, Leda Nature Reserve	PERTH 05005035
<i>polystachyus</i>	<i>polystachyus</i>	<i>J.F. Smith</i> 221	On edge of car park at Kalbarri shopping centre	PERTH 06593003
<i>polystachyus</i>	<i>polystachyus</i>	<i>G.M. Storr</i> s.n.	Cunderdin	PERTH 00842230
<i>polystachyus</i>	<i>polystachyus</i>	<i>L.S.J. Sweedman</i> 6736	7.7 km S of the Onslow and Old Onslow Rds turnoff	PERTH 07379439
<i>pullenii</i>	<i>giganteus</i>	<i>Hf. Eichler</i> 22488	Hidden Valley, just N of Kununurra	* CANB 267398
<i>pullenii</i>	<i>giganteus</i>	<i>D.E. Symon</i> 5271	3 miles S of Ord River Crossing, 64 miles N of Halls Creek	PERTH 00226688, ADW, M

most to the separation between vars *longistachyus*+*pullenii*+indet and vars *polystachyus*+*arthrotrichus* (Figure 2A; Table 3) are ovary summit indumentum ( $R = -0.7828$ ), pedicel morphology ( $R = 0.7629$ ), staminal cup shape ( $R = -0.7629$ ) and ovary shape ( $R = -0.7629$ ), while those contributing most to the spread of samples within each group are tepal length ( $R = 0.7863$ ), bract length ( $R = 0.7645$ ) and bracteole length ( $R = 0.7515$ ).

Discussion

The morphometric analysis suggests that two distinct species should be recognised in *Ptilotus polystachyus sens. lat.* rather than the four varieties recognised by Benl (1983). The analysis also supports the synonymy of var. *arthrotrichus* under var. *polystachyus* proposed by Bean (2008) and indicates that var. *longistachyus* and var. *pullenii* should be synonymised at a higher taxonomic rank.

As previously stated, many of the characters used by Benl (1983) to distinguish the varieties vary continuously among all specimens and cannot be used to accurately identify them. For example, Benl (1983: 271) regarded var. *longistachyus* and var. *pullenii* as differing primarily in the colour of the tepal tips, as well as in the diameter of the spikes, the shape of the spike apex, and in the form, hairiness and midrib of the bracts, and cited *A.S. George* 12813 (var. *longistachyus*, PERTH 0227706) and *D.E. Symon* 5271 (var. *pullenii*, PERTH 00226688) as being specimens which clearly showed these differences. Re-examination of these specimens could not discern any significant differences between them in these critical characters, with the diameter and shape of the spike related to their age

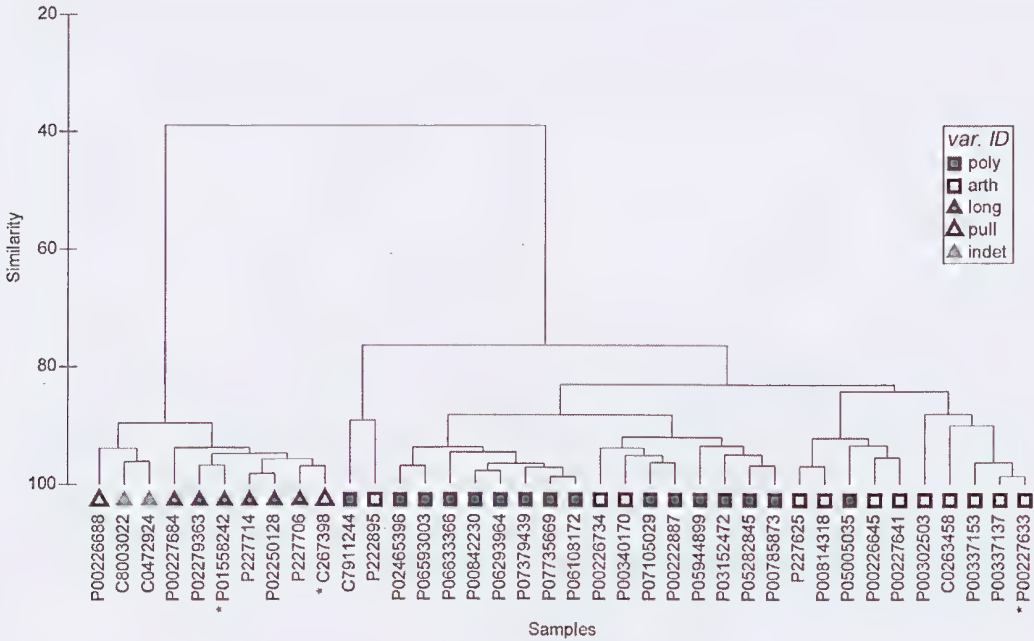


Figure 1. UPGMA dendrogram of the four varieties of *Ptilotus polystachyus* based on 34 specimens by nine characters, using the Gower metric. Specimens labelled by their PERTH (P) and CANB/CBG (C) sheet numbers. Specimens marked with an asterisk (\*) are types.

and the bract characters found to vary between spikes on each specimen. The inconsistency of spike colour for taxon identification in *P. polystachyus sens. lat.* has already been noted by Bean (2008: 245). Cluster analysis found that *A.S. George* 12813 was most similar to the type of var. *pullenii* than to other specimens of var. *longistachyus* (Figure 1) and a close association between *A.S. George* 12813 and *D.E. Symon* 5271 was also recovered in the ordination (Figure 2B). Type specimens of each of these varieties were also closely associated (Figure 2B), in the middle of the spread of samples. Based on this morphometric analysis it is evident these two varieties should be synonymised.

Similarly, Benl(1983: 274) cited *A.C. Beauglehole* 54017 (PERTH00227684) as having (unspecified) morphology intermediate between var. *longistachyus* and var. *polystachyus*, and used this assertion

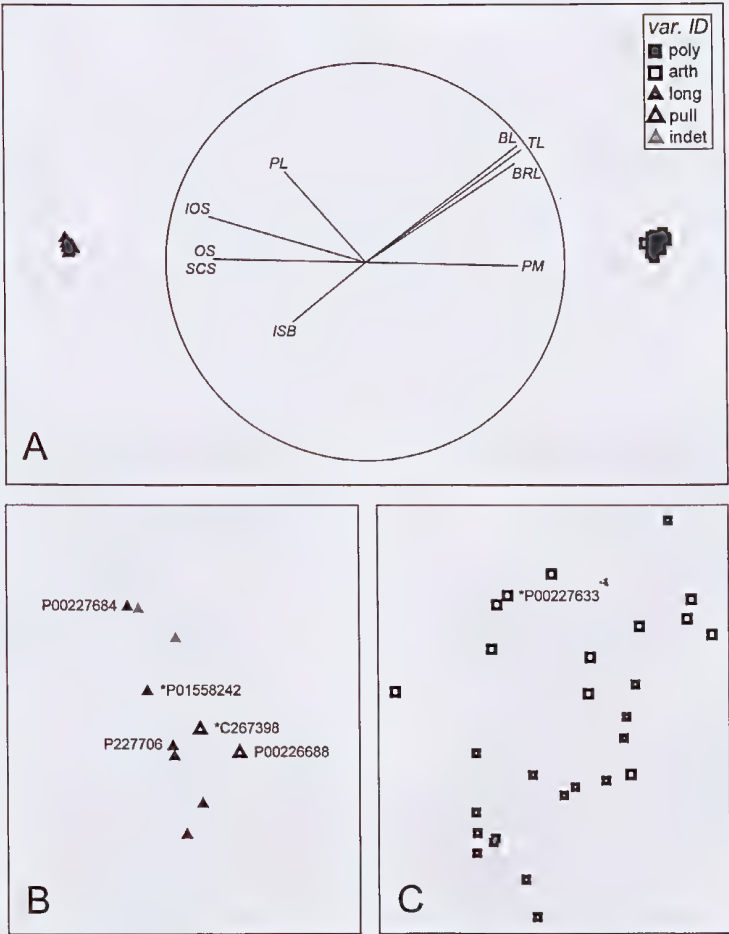


Figure 2. Two-dimensional NMDS ordination of the four varieties of *Ptilotus polystachyus* based on 34 specimens by nine characters, using the Gower metric. The direction of contribution of each character to the ordination, calculated by the Spearman rank correlation coefficient, is illustrated in the circular inset. Character codes as for Table 1. A – ordination space showing the distant separation of vars *longistachyus*+*pullenii*+*indet* from vars *polystachyus*+*arthrotrichus*; B – magnified ordination of vars *longistachyus*+*pullenii*+*indet* showing the positions of the types of var. *longistachyus* and var. *pullenii* and of specific samples cited by Benl (1983) (see text for discussion); C – magnified ordination of vars *polystachyus*+*arthrotrichus* showing the position of the type of var. *arthrotrichus*. Specimens marked with an asterisk (\*) are types. Refer to Table 2 for specimen information.



**Table 3.** Spearman rank (R) correlation coefficients between the characters used to create the NMDS ordination and the ordination axes. Character codes as for Table 1.

	BL	BRL	TL	PL	IOS	ISB	OS	SCS	PM
MDS 1	0.7645	0.7515	0.7863	-0.4027	-0.7828	-0.3654	-0.7629	-0.7629	0.7629
MDS 2	0.5839	0.4949	0.5645	0.4563	0.2291	-0.3009	0.0163	0.0163	-0.0163

to retain var. *longistachyus* at varietal rank. Both cluster analysis (Figure 1) and the ordination (Figure 2B) show that this specimen clearly groups with other samples of var. *longistachyus*, and with vars *pullenii*+indet, and that vars *longistachyus*+*pullenii*+indet are distantly separated from vars *polystachyus*+*arthrotrichus* (Figure 2A).

In contrast, characters used in Benl’s (1983: 273) key to separate vars *longistachyus*+*pullenii* from vars *polystachyus*+*arthrotrichus* (shape of the staminal cup and the ovary, and indumentum of the ovary summit) were found to have high Spearman rank correlation coefficients (Table 2) and were extremely reliable for separating these pairs of varieties. Pedicel morphology was not discussed by Benl (1960, 1979, 1983) but has been found here to be a perfect discriminator between vars *polystachyus*+*arthrotrichus* and vars *longistachyus*+*pullenii*. After flowers have been shed, it can be seen that vars *polystachyus*+*arthrotrichus* have squat pedicels (almost as broad as long) with a prominent disc at the apex, and that the bracts and bracteoles are closely aligned to each other. In vars *longistachyus*+*pullenii* the pedicels are slender (length to width ratio 7:1) with a greatly reduced disc at the apex, and the bracts and bracteoles are widely separated (Figure 3).

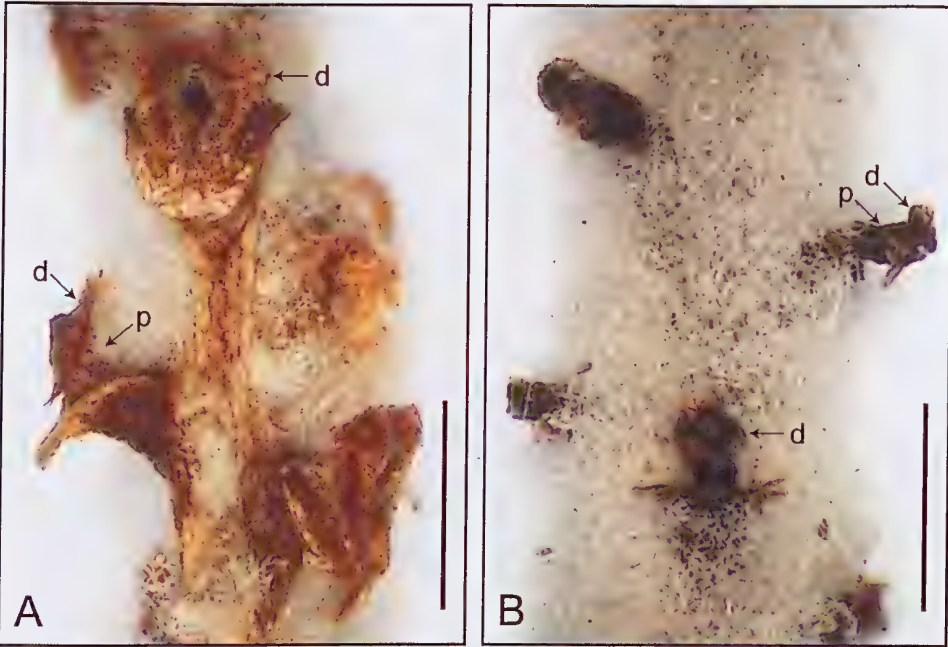


Figure 3. Comparative pedicel (p) and disc (d) morphology of *Ptilotus polystachyus* sens. lat. A – vars *polystachyus*+*arthrotrichus* (var. *arthrotrichus*, G. Byrne 1245), showing the prominent, robust disc at the apex of the squat pedicel; B – vars *longistachyus*+*pullenii* (var. *longistachyus*, A.A. Mitchell 8458), showing the small, disintegrating disc at the apex of the slender pedicel. The pedicel in profile at lower left has had the disc fall away completely.

Separation of samples among vars *polystachyus*+*arthrotrichus* is related to the length of tepals, bracts, bracteoles and pedicels, with most of the specimens identified prior to analysis as var. *arthrotrichus* having flowers at the larger end of the size range. Measurement values overlap between specimens of these varieties, however, as well as between vars *polystachyus*+*arthrotrichus* and vars *longistachyus*+*pullenii* (Table 4), and are not reliable for distinguishing taxa.

**Table 4.** Morphological comparison of *Ptilotus polystachyus* and *P. giganteus*.

Characters	<i>Ptilotus polystachyus</i>	<i>Ptilotus giganteus</i>
Bract length (mm)	3–7.1	2.2–3.8
Bracteole length (mm)	3.3–5.6	2.9–4.4
Tepal length (mm)	9–17	7.5–11.8
Staminal cup shape	Oblique	(Sub-) symmetrical
Staminal cup indumentum	Sparse short hairs	Copious long silky hairs
Ovary shape	Gibbous	Not gibbous
Ovary summit	Sparsely hairy or glabrous	Densely hairy
Style base	Sparsely hairy	Densely hairy
Style length (mm)	7–13.3	4.5–10.5
Pedicel after abscission	Squat, with prominent disc at apex	Slender, with reduced disc at apex

Based on the two clear groups recovered by the classification and ordination we recognise here two taxa, distinguishable from one another by a suite of qualitative characters (Table 4). As proposed by Bean (2008), *P. polystachyus* is accepted here as being a widespread and variable species that it would be meaningless to subdivide. Similarly, Benl’s (1983) var. *longistachyus* and var. *pullenii* should not be recognised as distinct entities but combined into a single taxon and recognised at species rank. The earliest available name for vars *longistachyus*+*pullenii* at species rank is *Trichinium giganteum* Cunn. ex Moq. (Moquin-Tandon 1849). Accordingly, the new combination *P. giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher is made here.

**Taxonomy**

***Ptilotus polystachyus*** (Gaudich.) F.Muell., *Fragm.* 6: 230 (1868). *Trichinium polystachyum* Gaudich. in Frec., *Voy. Uranie Bot.* 445 (1829); *Ptilotus polystachyus* var. *polystachyus*, *Mitt. Bot. Staatssaml. München* 7: 317 (1970); *Ptilotus polystachyus* f. *polystachyus*, *Nuytsia* 4: 273 (1983). Type: Shark Bay, Western Australia, s. dat. [September 1818], C. Gaudichaud-Beaupre, s.n. (syn: BM n.v., G n.v., P n.v., fide Benl (1983)).

*Trichinium alopecuroideum* Lindl. in T.Mitch., *Three Exped. Australia* 2: 12 (1838); *Ptilotus alopecuroideus* (Lindl.) F.Muell., *Fragm.* 6: 227 (1868); *Trichinium alopecuroideum* Lindl. var. *alopecuroideum*, *Trans & Proc. Roy. Soc. South Australia* 40: 61 (1916); *Ptilotus alopecuroideus* (Lindl.) F.Muell. f. *alopecuroideus*, *Mitt. Bot. Sataatssamml. München* 2: 402 (1958). Type: interior of New Holland [Byrnes Ck, New South Wales], 24 March 1836, T.L. Mitchell s.n. (holo: CGE n.v., digital image at BRI, fide Bean (2008); iso: BM n.v., K n.v., MEL n.v., fide Bean (2008)).

*Trichinium concicum* Lindl. in T.Mitch., *J. Exped. Trop. Australia* 363 (1848), *nom. illeg., non Spreng.* (1824).

*Trichinium alopecuroideum* var. *rubriflorum* J.M.Black, *Trans. & Proc. Roy. Soc. South Australia* 40: 61 (1916); *Ptilotus alopecuroideus* f. *rubriflorus* (J.M.Black) Benl, *Mitt. Bot. Staatssamml. München* 3: 518 (1960). *Type*: near Oodnadatta, South Australia, November 1914, *Staer s.n. (holo: AD n.v., fide Bean (2008))*.

*Ptilotus polystachyus* var. *arthrotrichus* Benl, *Mitt. Bot. Staatssamml. München* 7: 317 (1970); *Ptilotus polystachyus* f. *arthrotrichus* (Benl) Benl, *Nuytsia* 4: 273 (1983). *Type*: 6 miles [10 km] north of Roeburn, Western Australia, 17 October 1941, *C.A. Gardner* 6323 (*holo: PERTH!*; *iso: PERTH!*).

*Ptilotus polystachyus* f. *ruber* Benl, *Mitt. Bot. Staatssamml. München* 15: 169 (1979). *Type*: 28 km north-east of Shay Gap, Western Australia, 22 July 1977, *I.R. Telford* 59785 (*holo: CANB n.v., fide Bean (2008))*.

Erect, *annual* or short-lived *perennial herbs*, to 1 m high. *Stems* ribbed, sparsely to densely hairy with crisped, nodose or verticillate hairs. *Cauline leaves* alternate, oblanceolate, 10–80 mm long, 3–12 mm wide, sparsely or densely hairy with crisped, nodose or verticillate hairs, margins undulate. *Inflorescences* terminal, green, sometimes fading red, cylindrical, 20–210 mm long, 18–34 mm wide; *bracts* ovate to narrowly ovate, translucent or slightly straw coloured toward mid rib, 3.1–7.1 mm long, sparsely hairy with verticillate hairs, glabrescent; *bracteoles* broadly ovate, translucent, 3–5.6 mm long, glabrous or with scattered hairs. *Flowers* pedicellate; *pedicels* squat, 0.2–1.3 mm long with prominent disc at apex; *outer tepals* green, linear, concave, 9–17 mm long, densely hairy at base becoming sparse towards apex with long, silky, nodose hairs to 4 mm long, apex entire, rounded, slightly hooded, glabrous; *inner tepals* 9–17 mm long; *staminal cup* oblique, 0.9–1.5 mm long, glabrous; *stamens* 4; *staminodes* 1; *style* sigmoid, centrally fixed to ovary, 7–14 mm long, glabrous or sparsely hairy towards base; *ovary* obovoid, gibbous, glabrous or sparsely hairy. *Seed* slightly dull, brown, to 2.3 mm long.

*Distribution and habitat.* Current herbarium collections show that *P. polystachyus* occurs in all mainland States and the Northern Territory of Australia, however the species is absent from the tropical north. The distribution of this species abuts that of *P. giganteus* near Cape Leveque in northern Western Australia. *P. polystachyus* occurs on a wide range of soils in a variety of habitats and is commonly regarded as a disturbance opportunist, often dominating roadside verges.

***Ptilotus giganteus* (Cunn. ex Moq.) R.W.Davis & R.Butcher, *comb. nov.***

*Trichinium giganteum* Cunn. ex Moq. in A.P. de Candolle, *Prodr.* 13(2): 296 (1849). *Type*: Montague Sound, north west coast [Western Australia], 1820, *A. Cunningham* 201 (*holo: G-DC n.v.; iso: BM n.v., CGE n.v., K n.v., MEL n.v., NSW n.v., P n.v., fide Bean (2008))*.

*Ptilotus longistachyus* W.Fitzg., *J. Proc. Roy. Soc. W. Australia* 3: 138 (1918); *Trichinium longistachyum* (W.Fitzg.) C.A.Gardner, *Enum. Pl. Austral. Occid.* 40 (1930); *Ptilotus polystachyus* var. *longistachyus* (W.Fitzg.) Benl, *Mitt. Bot. Staatssaml. München*, 3: 518 (1960). *Type*: between Station Creek and Isdell River, Western Australia, June 1905, *W.V. Fitzgerald* 1080 (*holo: PERTH!* (photo M); *iso: E n.v., NSW n.v., fide Bean (2008))*.



*Ptilotus pullenii* Benl, Mitt. Bot. Staatssamml. München 15: 169 (1979); *Ptilotus polystachyus* (Gaudich.) F. Muell. var. *pullenii* (Benl) Benl, Nuytsia 4: 271 (1983). Type: Hidden Valley, just north of Kununurra, Western Australia, 15° 47' S, 128° 45' E, 25 April 1977, H. Eichler 22488 (holo: CANB!).

Erect, annual herbs, to 1 m high. Stems ribbed, sparsely hairy with nodose hairs. Cauline leaves alternate, oblanceolate, 10–80 mm long, 3–12 mm wide, sparsely hairy with crisped, nodose hairs, margins undulate. Inflorescences terminal, green, sometimes fading red, cylindrical, 20–180 mm long, 20–27 mm wide; bracts narrowly ovate, straw coloured becoming translucent toward margins, 2–3.8 mm long, sparsely hairy with crisped, nodose hairs; bracteoles broadly ovate, translucent, 2.8–4.4 mm long, glabrous. Flowers pedicellate; pedicels slender, 0.7–1.6 mm long with reduced disc at apex; outer tepals green, linear, concave, 7.5–11.8 mm long, densely hairy at base becoming sparse towards apex with long, silky, nodose hairs to 4 mm long, apex entire, rounded, slightly hooded, glabrous; inner tepals 7.5–11.8 mm long; staminal cup sub-symmetrical, to 0.5 mm long, glabrous; stamens 4; staminodes 1; style sigmoid, centrally fixed to ovary, 4.5–10.5 mm long, densely hairy towards apex; ovary obovoid, densely hairy. Seed slightly dull, brown, to 1.8 mm long.

**Distribution and habitat.** *Ptilotus giganteus* is found in the Northern Botanical Province of Western Australia, extending across the Northern Territory border into Kakadu National Park. Within Western Australia the species occurs roughly from Cape Leveque, north-north-west of Derby in the Dampierland IBRA region, across the North Kimberley through the Ord-Victoria Plains and Victoria Bonaparte IBRA regions, with some collections from the Central Kimberley IBRA region. *P. giganteus* appears restricted to sandstone hills and plateaus.

### Acknowledgements

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## ***Enekbatus*, a new Western Australian genus of Myrtaceae with a multi-locular indehiscent fruit**

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### **Abstract**

Trudgen, M.E. & Rye, B.L. *Enekbatus*, a new Western Australian genus of Myrtaceae with a multi-locular indehiscent fruit. *Nuytsia* 20: 229–259 (2010). A new myrtaceous genus endemic to south-western Australia is described as *Enekbatus* Trudgen & Rye. It is related to *Rinzia* Schauer and several other genera, all of which have an unmodified anther type, a multi-locular ovary and reniform seeds. However, the indehiscent fruit of the new genus separates it from the other members of this group. Ten species are recognised here; of these seven are newly described as *Enekbatus bounites* Trudgen & Rye, *E. cristatus*, *E. dualis*, *E. cremaeus*, *E. longistylus*, *E. planifolius* and *E. sessilis*. The new combinations *Enekbatus cryptandroides* (F.Muell.) Trudgen & Rye, *E. clavifolius* (S.Moore) Trudgen & Rye and *E. stowardii* (S.Moore) Trudgen & Rye, are made for three species that were previously included in *Baeckea* L. s. lat. This revision includes a key to the species, distribution maps and illustrations.

### **Introduction**

A new myrtaceous genus, *Enekbatus*, is described here to recognise the morphological isolation of a group of species that are all endemic to the south-west of Western Australia. The distribution of the new genus extends from north of Geraldton to south of Merredin and inland to the western part of the Great Victoria Desert.

*Enekbatus* belongs to the tribe Chamelaucieae *sensu* Wilson *et al.* (2005), in a group of genera including *Rinzia* Schauer that have multi-locular fruits containing unfacetted seeds of a more or less reniform shape. Unlike all other members of the reniform-seeded group, *Enekbatus* has a toughly fibrous to ossified, indehiscent fruit. So unusual is this fruit in comparison with those of most other genera of the Chamelaucieae, that it has sometimes been mistaken for a gall.

Two early publications that had a major impact on the development of generic concepts for Australian Myrtaceae, Schauer (1843) and Bentham (1867), did not cite material of any of the species now referred to *Enekbatus* as the earliest collection of this species group was apparently made in 1875. Had he seen good material, Schauer would probably have recognised the need for a separate genus, as he carefully delimited genera, including some that are certainly less morphologically isolated than *Enekbatus*.

Unlike Schauer, Bentham (1867) presented a very broad concept of *Baeckea* L. and used simple but sometimes superficial characters for distinguishing it from the few related genera he recognised. While this was a practical approach suited to the limited time available for writing a large flora, it does not



cope with the overall variation and the many more species we now know exists. For example, using Bentham's generic key, those species of *Enekbatus* with superposed ovules would fall into *Scholtzia* Schauer and those with collateral ovules into *Baeckea*.

Accepting Bentham's generic delimitations, Mueller (1876) named one of the taxa now considered to belong in *Enekbatus* as *Baeckea cryptandroides* and Moore (1920) named two more as *B. clavifolia* and *B. stowardii* respectively. A fourth species has been known by two of C.A. Gardner's manuscript names and was briefly described, as *Baeckea aff. cryptandroides*, in *Flora of Central Australia* (George & Trudgen 1981).

## Materials and methods

This study was based on the gross morphology of dry herbarium material, supplemented with field observations, including measurements of the diameter of fully opened flowers. Branchlet measurements were taken from unbranched flowering branchlets and did not include the length of the flowers. The number of oil glands per row in the leaf was recorded by counting the glands in the two most prominent rows (these are adjacent to the midrib, one on each side) on the abaxial surface. Bracteole widths were measured with the bracteoles flattened. Hypanthium length was taken after anthesis but prior to its enlargement in fruit. Measurements of petals and other floral organs were taken only from very well pressed flowers.

Distribution maps were based on those of *FloraBase* (Western Australian Herbarium 1998–). Codes used for the biogeographic regions are those defined by Thackway & Creswell (1995). Holotypes of the new taxa have been lodged at PERTH.

## Morphology

Fruit and seed characters are particularly variable in *Enekbatus* and are of major importance in distinguishing the species. Most of the diagnostic characters of the genus are illustrated in Figures 1–3.

### Habit

The species placed in *Enekbatus* genus are relatively uniform in habit, being low-growing shrubs 0.2–1.3 m high (Figure 1B), all or most of them with a marked tendency to produce adventitious roots from horizontal radiating branches when the opportunity arises. However, sometimes all branches are separated from the soil, for example by rock or surrounding plants, and unable to produce such roots. The lateral branchlets tend to have a dense terminal cluster of leaves and a bare basal portion with densely packed prominent nodes, and, when in flower, usually have a solitary, terminal or subterminal flower. Occasionally they are two- or three-flowered.

### Bracts and flowers

The flowers are sessile or almost so, although in *Enekbatus planifolius* they usually have a small anthopodium (up to 0.5 mm long). There are usually 1–3 small bracts that combine with a pair of

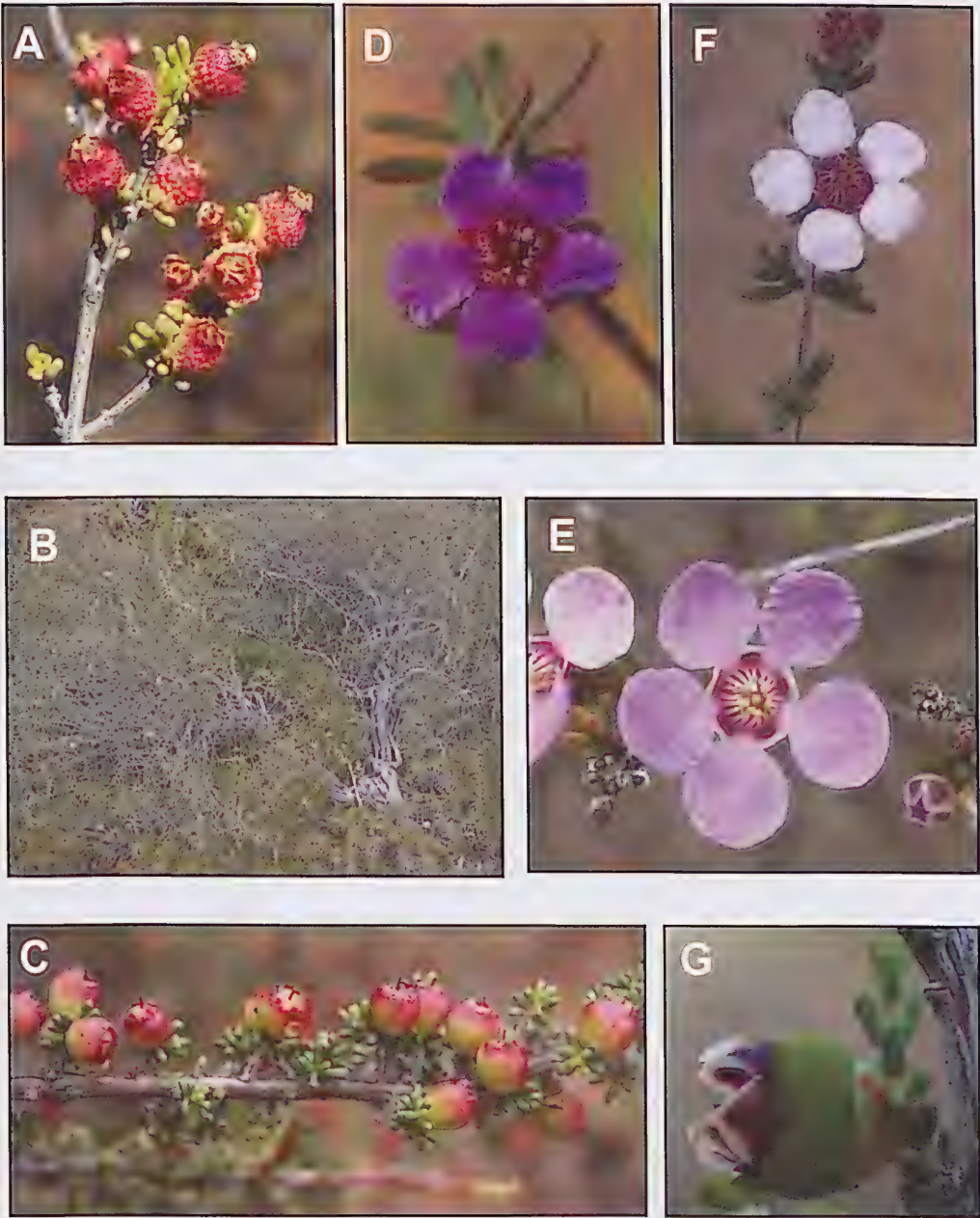


Figure 1. Images of *Enekbatus* species, taken by B.L.Rye. A – fruiting branch of *E. clavifolius* (B.L. Rye 231082 & M.E. Trudgen); B – partially prostrate shrub of *E. dualis* (B.L. Rye 239051 & M.E. Trudgen), growing with *Borya* on a granite outcrop; C – fruiting branch of *E. dualis* (B.L. Rye 239052 & M.E. Trudgen), with a cavity in one fruit probably as a result of insect attack; D – flower and compressed leaves of *E. planifolius* (B.L. Rye 231003 & M.E. Trudgen); E – flower, bud and leaves of *E. sessilis* (M.E. Trudgen 22066 & B.L. Rye); F – flower, bud and leaves of *E. stowardii* (B.L. Rye 231034 & M.E. Trudgen); G – fruit of *E. stowardii* (B.L. Rye 231034 & M.E. Trudgen).

large bracteoles to form an involucre subtending each flower. Except in *E. dualis*, the bracteoles are very broad (broader than long) and at least cover the base of the hypanthium (e.g. Figure 2K & N) and in some cases (e.g. Figure 2D) are large enough to enclose the entire hypanthium. In *E. dualis*, the two bracteoles are longer than they are broad and too small to obscure even the base of the hypanthium from view (Figure 3J). In all the other species, the bracteoles enclosing the young buds and the hypanthium of the flower and young fruit presumably offer protection from desiccation, and also from attack by phytophagous insects. Evidence of such attack on a mature fruit is visible near the centre of Figure 1C.

### Hypanthium, petals and stamens

The hypanthium is adnate to the ovary for at least the lower half of its length, with a free tube above the fused section. The petals are uniformly coloured (Figure 1), varying from very pale to deep pink. Occasionally they have been recorded as white, but they normally have some pink colouring at least when they first open. Antipetalous processes (as defined in Trudgen 1986) are absent in most specimens but are sometimes present in a rudimentary form at the base of the petal claw. For example, the flowers on one of the specimens (*A.S. George* 7989) of *Enekbatus cryptandroides* have about six minute processes, mostly less than 0.1 mm long, opposite each petal.

In *Enekbatus clavifolius* (Figure 3A), and often also in *E. cryptandroides*, there are ten stamens, with the antipetalous ones distinctly longer than the antisepalous ones. Other species have more numerous stamens occupying all positions around the circumference of the flower (e.g. Figure 2E), the maximum number recorded being 25. Each stamen has a slender filament and a versatile, dorsifixed anther. The anthers have two parallel cells which are longitudinally dehiscent, and on the connective there is a free, more or less globular, connective gland.

### Gynoecium

Although ovule number in *Enekbatus* is almost constant at two per loculus, the species fall into two main groups on the basis of their ovule arrangement. Four species (Table 1) have the two ovules superposed, so that the upper one is attached to the placenta at its lower end while the lower one is attached at its upper end (in relation to the loculus). In these taxa each loculus usually becomes divided into two compartments by a horizontal partition before the fruit matures (Figure 3M). The remaining species (Table 2) have two collateral ovules in each loculus (see Figures 2O and 3C), although *E. stowardii* does very occasionally produce an additional one or two ovules below the two collateral ones, so that the number of ovules per loculus ranges from two to four. The species with superposed ovules tend to have more loculi than those with collateral ovules.

### Fruit

All species of *Enekbatus* have a multi-locular, indehiscent fruit; however, there is significant variation between species in fruit shape and surface ornamentation. The shape varies from depressed globular to obovoid, while the surface can be smooth, pitted or tuberculate. Some of this variation is shown in Figures 1–3.

Paralleling the range of fruit shape, there is great variation in the degree of thickening of the fruit and in which tissues are most modified. At one extreme the fruit of *E. planifolius* and *E. stowardii*



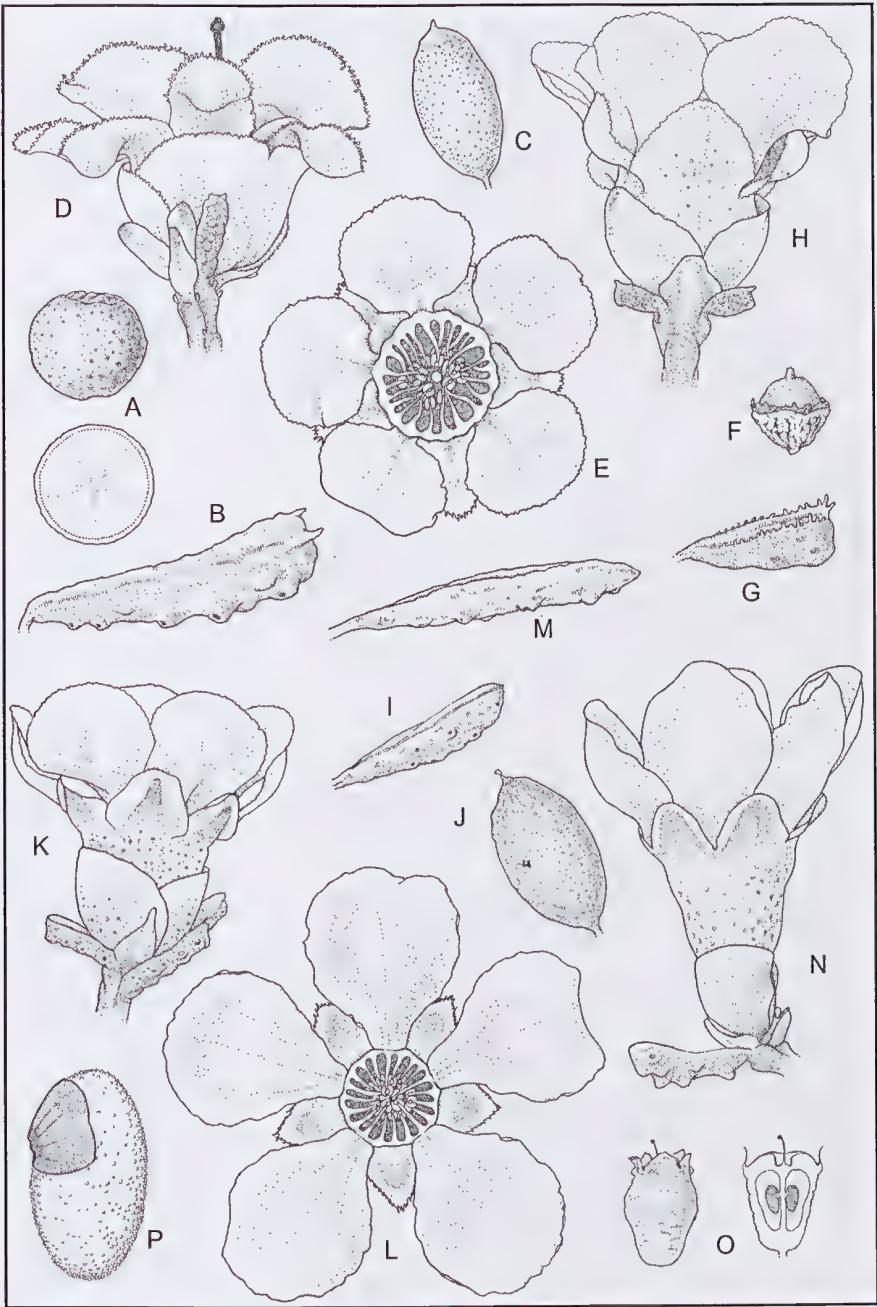


Figure 2. A – *Enekbatus bounites*, fruit, side view and TS ( $\times 5$ ); B–F. *E. eremaeus*. B – leaf ( $\times 15$ ), C – gall ( $\times 5$ ), D – side view of flower ( $\times 7$ ), E – top view of flower ( $\times 6$ ), F – fruit ( $\times 5$ ); G,H. *E. longistylus*. G – leaf ( $\times 12$ ), H – side view of flower ( $\times 8$ ); I–L. *E. sessilis*. I – leaf ( $\times 12$ ), J – gall ( $\times 5$ ), K – side view of flower ( $\times 10$ ), L – top view of flower ( $\times 8$ ); M–P. *E. stowardii*. M – leaf ( $\times 12$ ), N – side view of flower ( $\times 8$ ), O – fruit with style, side view and LS ( $\times 4$ ), P – seed ( $\times 20$ ). Drawn from PERTH specimens A.S. George 14870 (A), J.S. Beard 6542 (B, C), P.G. Wilson 7356 (D, E), J.D. Pearson 2935 (F), J.S. Beard 6699 (G, H), M.E. Trudgen 1416 (I–K), M. Hislop 496B (L), L.A. Craven, F.A. Zich & A.M. Lyne 8903 (M,O,P) and F. Keast L6D 245 (N).

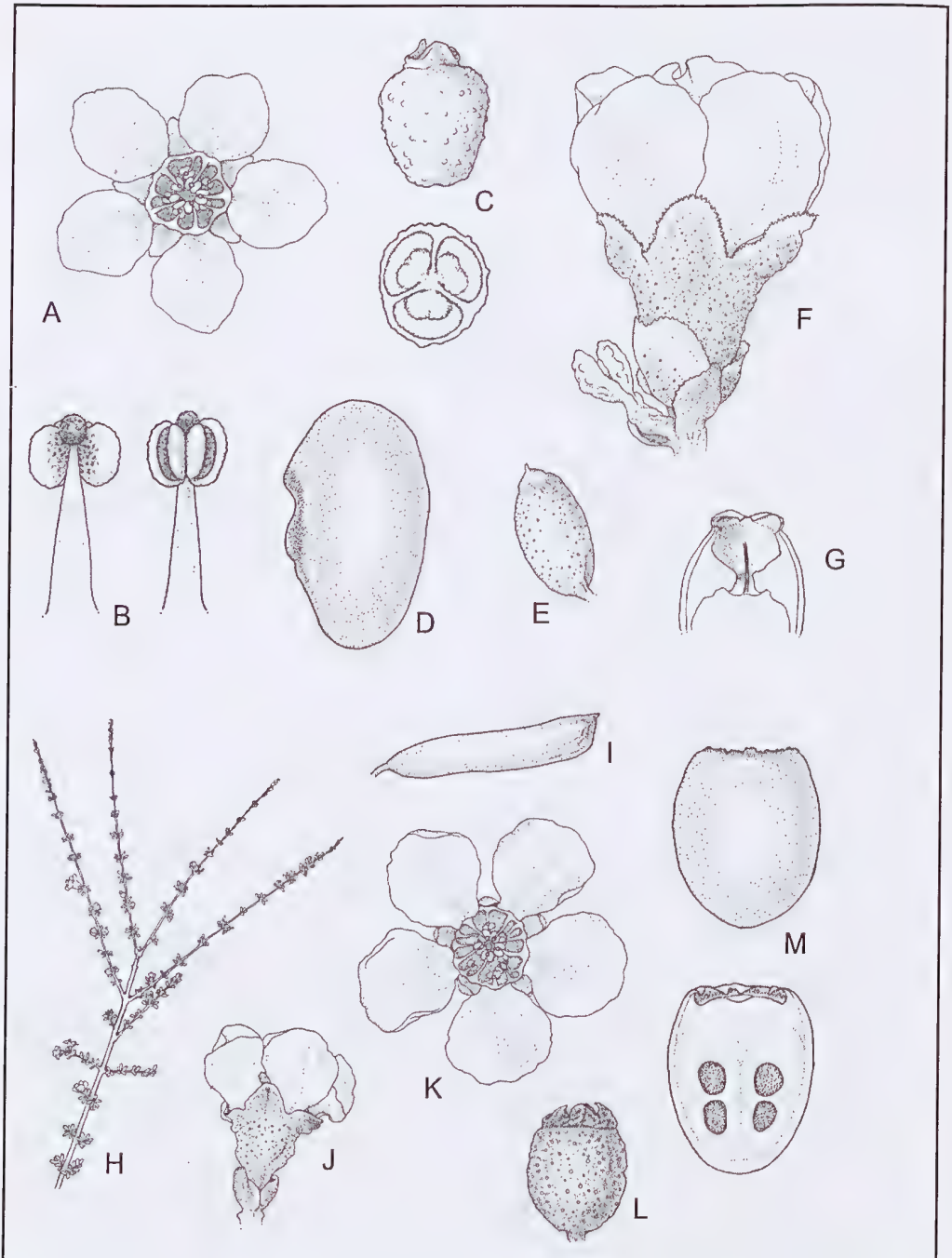


Figure 3. A–D. *E. clavifolius*. A – top view of flower ( $\times 10$ ), B – two views of stamen ( $\times 50$ ), C – fruit, side view and TS ( $\times 6$ ), D – seed ( $\times 20$ ); E–G. *E. cryptandroides*; E – gall ( $\times 5$ ), F – side view of flower ( $\times 8$ ), G – LS of top of fruit, with base of style ( $\times 5$ ); H–M. *Enekbatus dualis*. H – flowering branch ( $\times 1$ ), I – leaf ( $\times 20$ ), J – side view of flower ( $\times 8$ ), K – top view of flower ( $\times 8$ ), L – young fruit with pustules ( $\times 8$ ), M – old fruit, side view and LS ( $\times 8.5$ ). Drawn from MEL specimen M. Koch 2943 (D) and from PERTH specimens B.C. Haberley 304 (A, B), M. Koch 2791 (C), L. Sweedman 2269 (E, G), R.D. Royce 10476 (F), J.S. Beard 4969 (H,K), A.L. Payne 3787 (I,J) and M.E. Phillips WA/68 1380 (L, M).

**Table 1.** Comparison of the morphology of the species of *Enekbatus* with superposed ovules. All measurements are in mm. \*proportion of length of hypanthium enclosed in flowering stage. \*\* keel very prominent (++), or moderately prominent (+)

	<i>Enekbatus bounites</i>	<i>Enekbatus cristatus</i>	<i>Enekbatus dualis</i>	<i>Enekbatus sessilis</i>
<b>leaves</b>				
length	2.5–3.5	3.5–5	0.8–2.3	1.0–3.5
width	0.3–0.5	0.3–0.5	0.3–0.5	0.4–0.6
thickness	0.3–0.5	0.3–0.4	0.3–0.4	0.3–0.4
<b>bracteoles</b>				
length	c. 1.5	1.2–1.6	0.6–1.2	1.3–2.2
width	c. 2.5	1.4–2	0.4–1	1.6–3
cover*	c. 1/2	c. 3/4	none	2/3–whole
<b>sepals</b>				
length	1–1.3	c. 1.5	0.4–0.7	0.8–1.5
keel**	+	++	+	+ or ++
<b>petal length</b>	4–4.5	2.5–3.3	2.2–2.7	2.5–4.5
<b>stamens</b>	c. 22	20–25	12–15	16–25
<b>gynoecium</b>				
loculi	4,5	4,5	3	4,5
style length	1.3–1.5	c. 1.6	1–1.5	1–1.6
<b>fruit</b>				
l/w ratio	0.7–0.8	0.9?	1–1.3	0.7–0.8
hypanthium	pitted	pitted	smooth	pitted
<b>seeds</b>				
length	1.3–1.5	unknown	1.2–1.5	1.1–1.4
adherent layer	rugose	rugose	none	rugose
testa cells	raised	raised	distinctly raised	raised

has the hypanthium fibrous and tough, but not much thickened or greatly expanded in comparison with the shape of the hypanthium in flower. These species also have the tissue of the ovary wall well developed, that is the ovary becomes somewhat similar to the valves of the dehiscent fruits found in related genera such as *Rinzia*. This includes the ovary having a definite bubbly texture on the inner surface similar to that of *Rinzia* and some other related genera. At the other extreme are species such as *E. bounites* (and other species with the ovules superposed) which have the fruit much expanded and its texture much changed. In this species, the hypanthium is also somewhat thickened, but most of the expansion of the fruit is due to tissue inside the hypanthium. It is not clear if this tissue originates from the ovary tissue becoming less specialised (parenchyma-like) than in related dehiscent genera, or if the ovary wall is much reduced and the tissue is from the inside layer of the hypanthium. What is clear is that this tissue becomes ossified as the fruit matures and completely encases the seeds.



**Table 2.** Comparison of the morphology of the species of *Enekbatus* with collateral ovules. All measurements are in mm. \*proportion of length of hypanthium enclosed in flowering stage. \*\* keel very prominent (++), moderately prominent (+) or not prominent, the sepals fully scarious (-).

	<i>Enekbatus clavifolius</i>	<i>Enekbatus cryptandroides</i>	<i>Enekbatus eremaeus</i>	<i>Enekbatus longistylus</i>	<i>Enekbatus planifolius</i>	<i>Enekbatus stowardii</i>
<b>leaves</b>						
length	1.5-3.5	2-3.5	1.3-3.7	0.8-1.5	3.5-4.5	1.7-4
width	0.5-0.8	0.5-0.8	0.5-1.1	0.3-1.3	1.1-1.4	0.5-1.2
thickness	0.4-0.6	0.5-0.7	0.4-0.5	0.2-0.4	0.1-0.3	0.35-0.6
processes	absent	absent	apical	marginal	absent	absent
<b>bracteoles</b>						
length	1.3-1.6	1-2	2.1-3.5	1.8-2.5	1.2-1.5	1.3-1.5
cover*	c. 3/4	c. 1/2	all	all	c. 1/4	1/4-1/3
<b>sepals</b>						
length	0.6-1	0.8-2	1.5-2.6	1.2-2.1	0.7-1.2	0.6-1.1
keel**	+	+	-	-	+	+
<b>petal length</b>	2-2.5	3-4.5	3-4	3-5	2-3	2-4
<b>stamens</b>	10	9-14	17-22	19-24	13-15	13-19
<b>gynoecium</b>						
loculi	3	3	3	3	2, 3	3, 4
style length	0.6-1.2	1.3-2.2	1.6-2.5	2.8-3.6	1.3-1.5	1-2
<b>fruit</b>						
l/w ratio	1-1.3	1-2	c. 0.7	c. 0.7	c. 1.5	c. 1.5
hypanthium	tuberculate	tuberculate	half rugose	smooth	pitted	pitted
petals	absent	absent	present	present	absent	absent
<b>seeds</b>						
length	1.4-1.8	unknown	1.4-1.6	unknown	1.3-1.4	1.3-1.6
adherent layer	scurfy	scurfy	none	unknown	none	none
testa cells	level	level	level	unknown	raised & patterned	raised & patterned

## Seeds

Fruits of most *Enekbatus* species tend to be single-seeded or less commonly two-seeded. However, in *E. clavifolius* the fruits commonly have two or more seeds, quite often with two seeds produced in a single loculus; this may also be the case in *E. cryptandroides*. The unfertilised ovules or early-aborted seeds are very compressed, commonly about 0.6 mm long, and dark brown or red-brown. At maturity, the seeds are up to 1.8 mm long and have quite variable shape (Figures 2P and 3D), but are usually not reniform like the seeds of related genera. Their soft, white embryo is enclosed in a pale brown-translucent to white membrane inside a thin or moderately thick, crustaceous testa. The testa is usually medium brown or orange-brown. Several species have the seed partially covered by an irregular layer of scurfy or rugose material formed from part of the wall of the loculus adhering to the testa. This layer covers a greater proportion of the testa in taxa which have superposed ovules than in those with collateral ovules (Figure 3C), as in the latter case one side of the seed is adjacent either to a second seed or to a piece of chaff. In most species, the testa is smooth or colliculate but *Enekbatus dualis* is unusual in having a deeply colliculate or shallowly tuberculate testa.

## Species groups within *Enekbatus*

In addition to the two main groups of species mentioned earlier that are distinguished primarily by whether the ovules are superposed or collateral in each loculus, the following subgroups can be readily distinguished within *Enekbatus*:

1. *Enekbatus clavifolius* and *E. cryptandroides* – distinguished by their tendency to have only 10 stamens arranged opposite the sepals and petals, their tuberculate, often multi-seeded fruit, and their smooth seeds that are partially covered by a scurfy adherent layer
2. *Enekbatus eremaeus* and *E. longistylus* – distinguished by the hyaline processes on their leaves, their long bracteoles and usually long style, their smooth or partially smooth, short fruit with persistent petals (seed morphology scarcely known).
3. *Enekbatus planifolius* and *E. stowardii* – distinguished by their apparently smooth but actually minutely pitted fruit, and their minutely colliculate seeds that have a large-scale pattern of shallow circular depressions.
4. *Enekbatus bounites*, *E. cristatus* and *E. sessilis* – distinguished by their 4- or 5-locular, pitted fruit, and colliculate seeds that are almost fully covered by a rugose adherent layer.
5. *Enekbatus dualis* – distinguished by its relatively small narrow bracteoles, its small sepals, and its often more or less reniform seeds with a prominently colliculate to shortly tuberculate testa.

## Affinities and distinction of *Enekbatus*

Within the tribe Chamelauciceae, *Enekbatus* can be distinguished quite simply by the combination of its multi-locular indehiscent fruit and its versatile anther (see Figure 3B) with dorsifixed cells opening in parallel slits and with a free connective gland. This unmodified anther type is considered to be primitive (Johnson & Briggs 1984) as it is very widespread and common in the Myrtaceae as

a whole. Many kinds of modified anther types also occur in the family, these modifications being particularly varied within the tribe Chamelaucieae. Other characters found in *Enekbatus*, such as the low habit with layering branches and more or less sessile, pink flowers usually subtended by an involucre that includes large persistent bracteoles, combine with the fruit and anther characters to characterise a very distinct entity.

*Enekbatus* has a number of the traits that characterise the 'reniform-seeded lineage' that was first recognised and described by Trudgen (1986). Apart from *Enekbatus*, the genera now considered to belong to this group are *Astus* Trudgen & Rye, *Euryomyrtus* Schauer, *Ochrosperma* Trudgen, *Rinzia* Schauer, *Triplarina* Raf. and several small genera that have yet to be described. Benthams (1867) placed all but one of the reniform-seeded species known at that time either in *Baeckea* sect. *Rinzia* or in *Baeckea* sect. *Euryomyrtus* (Schauer) Benth., the exception being the single species of *Triplarina*, because it did not have any stamens opposite the petals. Moore (1920) similarly placed the two species of *Enekbatus* he described in sect. *Euryomyrtus*, which was reinstated as a distinct genus by Trudgen (2001).

Many of the character states found in species of *Enekbatus* are shared with species in some or all of the other genera in the reniform-seeded group. In common with *Enekbatus* these genera have a free connective gland, dorsifixed anthers opening by longitudinal slits, a multi-locular ovary and the base of the style inserted in a depression or short tube. The uniform pink colour of the petals<sup>1</sup> in *Enekbatus* is also found in most of the other reniform-seeded genera, although usually in a smaller proportion of the species. More importantly, *Enekbatus* species have seeds that appear to have been derived from the typical reniform seed, but modified as a result of the indehiscent fruit of all species in the genus. Certainly the seeds are of a similar size to those of most of the other reniform-seeded genera, and the chaff is of the same kind as in those genera. Although the development of an indehiscent fruit has resulted in some species of *Enekbatus* having a thin testa with a smooth surface, other species have retained a thicker testa with a colliculate to shallowly tuberculate surface similar to that found in *Rinzia* and several other reniform-seeded genera.

The other genera in the reniform-seeded group can easily be distinguished from *Enekbatus* as they all have a dehiscent fruit (Table 3). Each of them can also be distinguished from *Enekbatus* by several other characters. For example, *Euryomyrtus* and *Rinzia* both differ from *Enekbatus* in having distinctly stalked flowers and in having an aril in most species; the former also differs in having parallel venation visible on the adaxial surface of its leaves and (usually) well developed processes opposite the petals, while the latter also differs in its broad, flattened filaments.

Molecular data including a single species of *Enekbatus* (Wilson *et al.* 2004) have confirmed the placement of the genus in the Chamelaucieae. Subsequent unpublished data (Peter Wilson pers. comm. 2010) sampling seven species from all species groups in the genus have indicated that *Enekbatus* is related to reniform-seeded genera such as *Rinzia*. An analysis using the nuclear ETS region gave fairly good support for the genus being monophyletic.

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<sup>1</sup> This is a relatively unusual character among other species groups that Benthams (1867) included in *Baeckea* s. lat., most of which have uniformly white petals or white petals with the outermost one, i.e. the one exposed in the bud, blotched on the outside with red or pink.



**Table 3.** Morphological characters of significance in distinguishing *Enekbatus* from other genera in the reniform-seeded group.

<i>Enekbatus</i>	Other reniform-seeded genera
Most species known to produce adventitious roots from horizontal branches	Lacking adventitious roots (except in some species of <i>Rinzia</i> )
Flowers more or less sessile	Flowers usually with a well developed peduncle and/or anthopodium
Bracteoles usually large and combined with bracts in an involucre	Bracteoles usually small and separated from bracts (if present) by a peduncle
Fruit 2–5-locular, indehiscent, thick-walled, toughly fibrous to ossified.	Fruit 2- or 3-locular, dehiscent, thin-walled to crustaceous (not ossified)
Seeds irregularly obovoid to ellipsoid or reniform; testa often thin, sometimes partially or largely enclosed by a scurfy or rugose adherent layer of the loculus wall; aril absent	Seeds reniform or sub-reniform; testa thick, never with loculus wall adherent; aril often present
Ovules 2 per loculus (very rarely 3 or 4), superposed in some species and collateral in others	Ovules 2–14 per loculus, collateral, in an arch or radial, never superposed

### Distribution and phenology

*Enekbatus* is endemic to Western Australia, occurring in the northern parts of the South West Botanical Province and extending well inland from there into the Eremaean Botanical Province. In the former province it occurs in the Geraldton Sandplains Bioregion and the northern to central parts of the Avon Wheatbelt Bioregion. In the latter province it occurs in the northern part of the Yalgoo Bioregion, the eastern two-thirds of the Murchison Bioregion, the western part of the Great Victoria Desert, and has one record in the the northern part of the Coolgardie Bioregion (Figure 4).

An unusual feature of the distribution of *Enekbatus*, is the apparent disjunction of at least 200 km between the eight taxa that occur fully or partly within the South West Botanical Province and the two far-inland species of the Eremaean Botanical Province. While the distribution of the genus is predominantly well inland, *Enekbatus bounites* and *E. cristatus* occur close to the west coast.

The flowering period recorded for the genus as a whole extends from June to October, with a peak in August. There was no evidence of any significant differences in flowering time between those species whose ranges overlap. However, no species have been observed co-existing at any of the locations visited during the current study, suggesting that habitat differences may be the primary factor keeping those species reproductively isolated.

### Insect associations

Floral galls containing a single wasp larva are fairly common on most species but have not been seen on *Enekbatus dualis*. Several of these galls are illustrated (Figures 2C & J and 3E). They are 2.5–6 mm long, fusiform to ellipsoid, and commonly have a rounded apical mucro formed apparently

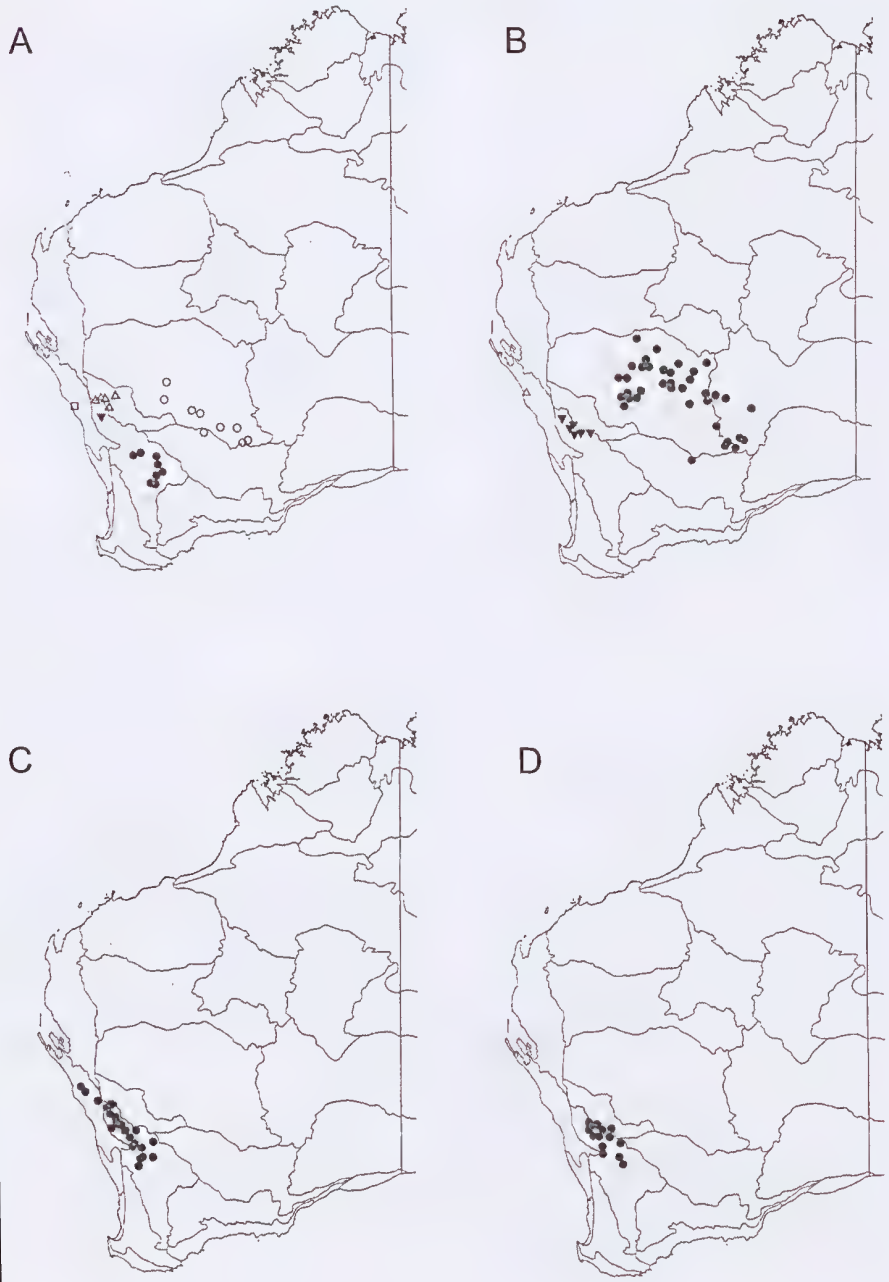


Figure 4. Distribution maps. A – *Enekbatus bounites* □, *E. clavifolius* ●, *E. cryptandroides* ○, *E. dualis* △ and *E. planifolius* ▼; B – *E. cristatus* △, *E. eremaeus* ● and *E. longistylus* ▼; C – *E. sessilis*; D – *E. stowardii*.

from the base of the style. Their base is often subtended by small bracts. Occasionally, an exoskeleton may be left protruding from the summit of the gall by an emerged insect, as found on the *R. Meissner* & *Y. Caruso* 297 specimen of *Enekbatus stowardii*.

Stem galls are occasionally present on the branchlets. These are fusiform to globular, with leaves attached or axils clearly visible.

Many species of native bees have been reported (Houston 2000) visiting the flowers of a species identified as *Baeckea stowardii*, presumably a species of *Enekbatus* although not necessarily *E. stowardii*. The apparently unspecialised, open flowers of *Enekbatus* probably attract a wide variety of insects rather than showing any great pollinator-specificity.

### Taxonomy

#### *Enekbatus* Trudgen & Rye, *gen. nov.*

Frutices glabri. Folia opposita, decussata, parvula, crassa. Flores sessiles vel subsessiles, per bracteolas 2–5 subteni. Hypanthium per bracteolas ex parte vel omnino occultum, per saltem dimidio longitudino ad ovarium adnatum. Sepala 5, in fructu persistentia. Petala 5, ungue basali brevi. Stamina 10–25 in unum verticillum dispositis; filamenta filiformia, antipetalina longissima; antherae dorsifixae, versatiles, cellulis parallelibus longitudinaliter dehiscentibus, connectivum glande plus minusve globulari. Cellulae ovarii plerumque 2-ovulatae; placentae axiales, versus apicem vel centrum ovarii posita. Styli basis in depressione inserta. Fructus indehiscens, 2–5-locularis, durus, pariete crasso. Semina obovoidea vel reniformia; arillus carens.

*Typus: Enekbatus cryptandroides* (F. Muell.) Trudgen & Rye.

*Shrubs* low and spreading (0.2–1.3 m high), single-stemmed at the base but usually soon developing widely spreading decumbent or prostrate branches at ground level and frequently producing adventitious roots from these main branches, glabrous; upper stems with very short lateral branchlets in an opposite-decussate arrangement. *Leaves* opposite, decussate, tending to be densely crowded into clusters on minute lateral branchlets, the distal leaves of each cluster erect and the basal leaves somewhat to widely antrorse, but tending to be distant on flush growth, shortly petiolate; blade very small (up to 5 mm long), thick in most taxa (often semi-circular to almost rectangular in TS with the adaxial surface more or less flat and abaxial surface deeply rounded and often with a central longitudinal groove), concolorous, usually with several prominent oil glands in 2 or more rows often giving a tuberculate appearance to the abaxial surface, less prominently gland-dotted adaxially. *Inflorescence* of 1 or 2 flowers terminal or subterminal on each short branchlet or rarely in several axils on a branchlet, with the arrangement of flowers on a number of adjacent branchlets along the stems often resembling an interrupted spike or raceme; peduncles virtually absent or very reduced (less than 0.5 mm between stem and bracteoles), the flowers solitary and more or less sessile in the leaf axils. *Bracts and bracteoles* 2–5, opposite-decussate apart from an often solitary basal bract opposed to the subtending leaf, persistent, sessile; bracts (when present) smaller than the two bracteoles; bracteoles overlapping in most taxa to form a tight cup obscuring at least the base of the hypanthium, not or scarcely separated from the bracts below. *Hypanthium* adnate to ovary for at least half of its length, free and somewhat to distinctly flared above, often with a deep reddish tinge. *Sepals* 5, erect or slightly spreading, much smaller than petals, either scarious throughout or with the central basal portion herbaceous, persistent and closing inwards in fruit. *Petals* 5, spreading, distinctly but shortly clawed at base and broadly elliptic to



obovoid or circular above, pale pink to deep pink or purplish pink, sometimes almost white, entire or minutely lacinate, sometimes persistent in fruit. *Antipetalous processes* absent or very inconspicuous. *Androecium* of (9)10–25 stamens in a single whorl, when 10 then one opposite each sepal and petal, when more than 10 then one opposite each petal claw and the others fairly uniformly arranged in between, separated at the base or contiguous on an extremely short staminophore that dips opposite the sepals. *Filaments* filiform with a slightly to distinctly expanded base and tapering to apex, terete, the 5 antipetalous ones largest, often pink. *Anthers* dorsifixed, versatile, about as broad as long, the dorsal (abaxial) surface of the connective terminated by a gland; cells parallel but tilted away from one another so as to be semi-latticose, broad, elliptic, opening in longitudinal slits, pale yellowish; connective gland prominent, more or less globular, *c.* half as long as the cells at first, *c.* 1/3 as long as the cells after contents released. *Disc* convex or with central portion convex and with a distinct to almost obsolete central depression, pink, smooth or pustulate, becoming thickened and hard in fruit. *Ovary* 2–5-locular, inferior; placentas axile, small; ovules 2 per loculus (rarely 3 or 4 per loculus in *E. stowardii*), collateral or superposed (rarely both). *Style* terete, base inserted in the depression in disc; stigma very depressed-ovoid to disc-like, pale yellowish. *Fruit* indehiscent, inferior to about half inferior, obovoid to depressed-ellipsoid, toughly fibrous to ossified, 1-seeded or with 1 or 2 seeds per loculus, with the exposed part tending to become red distally or throughout or (in two species) apparently fully enclosed. *Seeds* of varied and somewhat irregular shape, usually obovoid, ellipsoid or broadly reniform, 1.1–1.8 mm long, without an aril, the hilum small; testa crustaceous but often very thin, smooth to shallowly tuberculate, often orange-brown, in some species partially or almost fully covered by a scurfy or rugose layer; hilum towards one end of seed (when ovules superposed) or more or less central on inner surface.

*Etymology.* From the Greek *enekbatos* – without outlet, referring to the indehiscent fruit.

**Key to the species of *Enekbatus***

- 1. Ovary 3–5-locular; ovules superposed in each loculus. Fruit very thick-walled between the loculi and tending to become divided transversely across the loculi as well
  - 2. Bracteoles 0.6–1.2 × 0.4–1 mm, somewhat folded-keeled, not encircling the hypanthium. Ovary 3-locular. (Mullewa to Wurarga to Mellenbyc Station) ..... ***E. dualis***
  - 2. Bracteoles 1.2–2.2 × 1.4–3 mm, curved, encircling and concealing at least the base of hypanthium. Ovary 4- or 5-locular
    - 3. Leaves mostly 1–2 mm long (rarely also with some leaves 2.5–3.5 mm long), with 3–6 main glands in the rows closest to the midvein. Occurring in sandy habitats, commonly in yellow sand, usually well inland. (Murchison River to Wongan Hills and Burakin) ..... ***E. sessilis***
    - 3. Leaves 2.5–5 long, with 7–12 main glands in the rows closest to the midvein. Occurring in sandstone habitats and possibly also in lateritic habitats not far inland
      - 4. Outer sepals somewhat to prominently keeled. Hypanthium usually largely exposed in flower, not becoming tuberculate. (Moresby Range) ..... ***E. bounites***
      - 4. Outer sepals very prominently keeled. Hypanthium usually largely covered in flower, often tuberculate in young fruit. (Kalbarri National Park) ..... ***E. cristatus***
- 1. Ovary 2–4-locular; ovules collateral in each loculus. Fruit not particularly thick-walled between the loculi, without transverse divisions

5. Bracteoles opaque, entire, only enclosing base of hypanthium. Hypanthium pitted. Ovary 2–4-locular
6. Leaves 1.1–1.4 mm wide, 0.1–0.3 mm thick. Ovary 2- or 3-locular, all specimens with 2-locular flowers common. (North of Morawa) ..... ***E. planifolius***
- 6: Leaves 0.5–0.8 mm wide, 0.35–0.6 mm thick. Ovary 3- or 4-locular. (Morawa to Cowcowing)..... ***E. stowardii***
- 5: Bracteoles with scarious hyaline edges, sometimes minutely lacinate, enclosing at least half of the hypanthium in flower (hypanthium may be largely exposed in fruit). Hypanthium tuberculate or smooth. Ovary 3-locular
7. Leaves with small hyaline processes near apex or along margins. Sepals scarious throughout. Petals persistent in fruit. Stamens 17–24
8. Leaves with small hyaline processes near apex only. Style 1.6–2.5 mm long. (Meekatharra to western edge of Victoria Desert) ..... ***E. eremaeus***
- 8: Leaves with small hyaline processes extending along margins. Style 2.8–3.6 mm long. (Tardun to Perenjori) ..... ***E. longistylus***
- 7: Leaves entire. Sepals with a somewhat herbaceous central portion. Petals deciduous. Stamens up to 14 (usually 10–12)
9. Bracteoles covering c. 1/2 of hypanthium in newly opened flowers. Petals 3–4.5 mm long. (Sandstone to Comet Vale)..... ***E. cryptandroides***
- 9: Bracteoles covering c. 3/4 of hypanthium in newly opened flowers. Petals 2–2.5 mm long. (Koorda to Bruce Rock)..... ***E. clavifolius***

### ***Enekbatus bounites* Trudgen & Rye, *sp. nov.***

Differt ab *Enekbato sessili* foliis et hypanthio pleurumque longioribus, fructu foveolis plus numerosis.

—4—

*Typus*: Howatharra area, Western Australia [precise locality withheld for conservation reasons], 27 August 1977, *N. Mcfarland s.n. (holo: PERTH 05830192; iso: CANB, K, MEL)*.

*Shrub* low and spreading, 0.2–0.3 m high; lateral branchlets mostly 5–15 mm long; flower galls not observed. *Petioles* 0.1–0.3 mm long. *Leaf blades* narrowly oblong to linear in outline, 2.5–3.5 mm long, 0.35–0.5 mm wide, 0.3–0.5 mm thick, obtuse, entire; abaxial surface with midline groove, with 7–10 prominent oil glands per row. *Bracts* 1 or 2, similar to bracteoles but somewhat more leaf-like. *Bracteoles* overlapping to form a tight cup round lower half of hypanthium, almost semi-circular, c. 1.5 mm long, c. 2.5 mm wide, thin, green with a red-tinged keel, margins entire. *Flowers* 1–3 (usually 1) terminating each branchlet, 10–11 mm diam. *Hypanthium* c. 2.5 mm long; adnate portion broadly cupped-obconic, green, with numerous small pits; free portion flared to c. 2.5 mm diam., apparently reddish or purple-tinged. *Sepals* very broadly to depressed ovate, 1–1.3 mm long, 1.2–2.5 mm wide, the outer ones distinctly keeled; keel herbaceous, probably reddish; margins broad, whitish, scarious, minutely lacinate. *Petals* 4–4.5 mm long, pink, entire or crenulate, deciduous in fruit. *Androecium* of c. 22 stamens; antipetalous filaments c. 1.5 mm long, probably pink; anthers c. 0.35 mm long. *Ovary* 4- or 5-locular; placentas attached half way up loculus; ovules 2 per loculus, superposed. *Style* 1.3–1.5 mm long; stigma c. 0.2 mm diam. *Fruit* depressed obovoid or globular, 3–4 mm long, 3.5–4.5 mm diam., very hard (ossified), commonly 1- or 2-seeded; hypanthium with numerous small

pits. *Seeds* broadly obovoid, 1.3–1.5 mm long, 0.8–1.2 mm wide, 0.6–0.9 mm thick; testa moderately thick, orange-brown, very densely and minutely colliculate, covered by an adherent rugose layer that is rather soft. (Figure 2A)

*Other specimens examined.* WESTERN AUSTRALIA: Howatharra area [precise localities withheld] 13 Sep. 1977, *A.S. George* 14870 (PERTH); Howatharra area, 7 July 1974, *D. & N. Mcfarland s.n.* (PERTH).

*Distribution and habitat.* Known only in Moresby Range, near Howatharra (north of Geraldton), in the South West Botanical Province: GS. Recorded in clayey soil over sandstone in low heath, at least one record from a hilltop. (Figure 4A)

*Phenology.* Flowers recorded in early July and fruits recorded from late August to mid September. Seeds measured from *A.S. George* 14870 and *N. Mcfarland s.n.* 27 Aug. 1977.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority Two. Known from only three collections from a very small area.

*Etymology.* From the Greek *bounites* – dweller in the hills, as this species appears to be restricted to a range of hills.

*Affinities.* Very closely related to *Enekbatus cristatus* and *E. sessilis*, differing from both in its longer hypanthium that is less fully covered in flower, also differing from the former in its lack of tubercles on the hypanthium and less prominently keeled sepals and from the latter in its lower habit and longer leaves, and usually more numerous pits on the fruit.

*Notes.* Only one of the specimens examined was in flower but two were in mature fruit. The flowering specimen had flowers that were as large as the largest recorded in *E. sessilis*, suggesting that it usually would have larger flowers than that species. More material is needed to confirm the status of this taxon but it appears to be distinct at least at the subspecific level.

In the relatively small sample of fruits opened in this study, all were either few-seeded or failed to produce a seed, and none had more than 1 fully developed seed in a single loculus although one loculus contained a viable seed and a late-aborted one. In fertile loculi, the seed was sometimes produced by the upper and sometimes by the lower ovule.

***Enekbatus clavifolius*** (S. Moore) Trudgen & Rye, *comb. nov.*

*Baeckea clavifolia* S. Moore, *J. Linn. Soc. Bot.* 45: 176 (1920). *Type:* Belka [north of Bruce Rock], Western Australia, 1916, *F. Stoward* 305 (*holo:* BM 000603461; *iso:* MEL 72572).

*Illustrations.* Blackall & Grieve (1980: 77) [as *Baeckea clavifolia*]; drawings on *C.A. Gardner s.n.* Sept. 1932.

*Shrub* 0.4–1 m high; lateral branchlets mostly 3–12 mm long; flower galls often present. *Petioles* 0.1–0.4 mm long. *Leaf blades* obovate to broadly ovate in outline, 1.5–2.5(3.5) mm long, 0.5–0.8 mm



wide, 0.4–0.6 mm thick, obtuse, entire; abaxial surface usually with 2–5 prominent oil glands in each row; adaxial surface flat to slightly concave. *Bracts* 1 or 2, ovate or broadly ovate, 0.8–1.3 mm long, 0.5–1 mm wide, entire, with a prominent keel. *Bracteoles* depressed ovate, 1.3–1.6 mm long, 1.6–2 mm wide, overlapping to form a cup covering c. 3/4 of the hypanthium, thin, rather petaline, sometimes shiny, entire. *Flowers* 1(2) and terminal on the branchlets, usually 6–7 mm diam. *Hypanthium* 1.3–1.7 mm long; adnate portion more or less obconic, pustulate; free portion flared to 2–2.5 mm diam., sometimes sparsely pustulate. *Sepals* triangular to semi-elliptic, 0.6–1 mm long, 0.8–1.2 mm wide; keel herbaceous, thickened, red-brown; margins whitish-translucent, entire or minutely lacinate, closing inwards in fruit. *Petals* 2–2.5 mm long, medium pink to deep purplish pink, more or less entire, deciduous in fruit. *Androecium* of 10 stamens; antipetalous filaments 0.6–0.8 mm long; anthers 0.25–0.3 mm long. *Ovary* 3-locular; placentas near top of loculi; ovules 2 per locus, collateral. *Style* 0.6–1.2 mm long; stigma 0.1–0.15 mm wide. *Fruit* broadly ovoid to almost globular with its apex sunken well below the top of the free tube of the hypanthium, 3.3–4.5 mm long, 3–4 mm diam., with base very thick and ossified but walls enclosing the seeds only moderately thickened, each locus with a whitish scurfy layer apparently derived from the ovary wall enclosing both ovules or seeds; hypanthium tuberculate. *Seeds* 1 or 2 per locus but often only 1 per fruit, irregularly obovoid (if two seeds present then tending to be flattened on surface where they abut one another), 1.4–1.8 mm long, 0.7–0.9 mm thick and not quite as wide as thick; testa thin, orange-brown, smooth, shiny, minutely areolate, partially covered by a whitish or brown scurfy layer, which adheres to the testa. (Figures 1A & 3A–D)

*Selected specimens examined.* WESTERN AUSTRALIA: Bruce Rock, 17 July 1970, *J.S. Beard* 5900 (PERTH); Merredin, 18 Sep. 1958, *W.H. Butler s.n.* (PERTH); Muntagin–Merredin, 15 Sep. 1963, *A.J. Cough* 129A (PERTH); Merredin, 31 Aug. 1926, *J.B. Cleland s.n.* [mixed material of three species] (AD); 6 km SE of Merredin and 4 km S of Callgar Rd, 31 Aug. 1985, *R.J. Cranfield* 5283 (PERTH); near Chandler Rd, 20 km NE of Merredin, Oct. 2002, *R. Davis* 10418 (PERTH); sources of Swan River, 1889, *M. Eaton s.n.* (MEL); Bullfinch–Mukinbudin road, 30 km from Mukinbudin, 28 Sep. 1997, *B.A. Fuhrer* 97/55 (PERTH); sandplains E of Bruce Rock, Sep. 1932, *C.A. Gardner s.n.* (PERTH); 13.7 km W of Bruce Rock towards Kellerberrin, 11 Sep. 1976, *B.C. Haberley* 304 (PERTH); 100 m along track on S boundary of Reserve 24125 off Chandler–Merredin road, c. 35 km SSW of Chandler, 29 Sep. 1997 & 24 Aug. 1999, *G.J. Keighery & N. Gibson* 2920 & 2923 (PERTH); Merredin, 29 Sep. 1923, *M. Koch* 2791 *p.p.* (MEL, NSW, PERTH); Merredin, 20 Nov. 1923, *M. Koch* 2791 *p.p.* (MEL, PERTH); Merredin, 8 Feb. 1923, *M. Koch* 2943 (MEL); between Cadoux and Koorda, 12 Sep. 1961, *R.D. Royce* 6649 (PERTH); 19.25 km SW of Chandler and 6.1 km from Brown Rd on Chandler–Merredin road, 15 Oct. 2003, *B.L. Rye* 231082 & *M.E. Trudgen* (AD, CANB, BRI, PERTH); Narkal Reserve, Koorda Shire, 11 Sep. 1998, *R. Storer* 191 (PERTH).

*Distribution and habitat.* Distributed in the inland part of the South West Botanical Province, from near Koorda east to near Champion and south-south-east to Bruce Rock: AW. Recorded in yellow or brown fine sand, in sandheath, open woodland and shrubland. One recent record is from yellow sandy soil over lateritic gravel, in *Allocasuarina acutivalvis*–*Melaleuca uncinata* scrub over *Acacia longispinea*. A few of the earlier records suggest that the same genera may be important components of the vegetation at other localities, with *Eucalyptus* also noted for one locality. (Figure 4A)

*Phenology.* Flowers: mainly late August to late September, also one record in mid July. Fruits: recorded in October, November and February.

*Conservation status.* Not currently listed as a priority for conservation. It is possibly at risk because of its distribution in the largely cleared wheatbelt, its known range extending c. 135 km. However, it was reported to be common along the boundary of one reserve that was sampled in 1999 and was also common at one of the localities visited in the current study.

*Affinities.* Closely related to *Enekbatus cryptandroides*, but distinguished by the shorter hypanthium, which is more fully covered by the bracteoles, shorter petals, stamens and style, and narrower stigma. Most specimens of *E. clavifolius* have very small leaves, but occasionally the leaves are as large as those found in most specimens of *E. cryptandroides*. From the few fruiting specimens examined, it appears that the fruit of *E. clavifolius* is shorter and more densely and prominently tuberculate than that of *E. cryptandroides*, but both species are variable in the size of the tubercles on the hypanthium in flower. The former species also tends to be a taller shrub, to have shorter leaves with fewer and less prominent oil glands and to have more deeply coloured petals, but these characters overlap considerably. *Enekbatus clavifolius* is unusual in the genus in having a constant stamen number of ten, with one stamen opposite each sepal and petal. Ten is also the most common stamen number in *E. cryptandroides* but that species sometimes has up to 14 stamens.

The disjunction between the known ranges of the two species is in excess of 350 km. Consequently, the habitat of *E. cryptandroides*, which occurs much further inland, is much drier than that of *E. clavifolius*.

*Notes.* In fruit, the stamens tend to persist under the incurved sepals. Fruits are not particularly woody in this species, in comparison with other members of the genus, and damage by insects or other organisms is sometimes apparent.

***Enekbatus cristatus* Trudgen & Rye, *sp. nov.***

Differt ab *Enekbato sessili* et *E. bounites* foliis longioribus, sepalis plus cristatis, petalis brevioribus, fructu tuberculatis.

*Typus:* Kalbarri National Park, Western Australia [precise locality withheld for conservation reasons], 13 August 1988, D.R. & B. Bellairs 911A (*holo:* PERTH 05830176).

*Illustration.* Drawings on C.A. Gardner 13271.

*Shrub* low and spreading, commonly 0.2–0.3 m high and c. 0.4 m wide but up to 1.2 m high; lateral branchlets mostly 1–10 mm long; flower galls often present. *Petioles* 0.1–0.3 mm long. *Leaf blades* narrowly oblong to linear in outline, 4–5 mm long, 0.3–0.4 mm wide, 0.3–0.4 mm thick, obtuse, entire; abaxial surface with midline groove, with 9–12 prominent oil glands per row. *Bracts* 1 or 2, narrowly ovate or ovate, shorter and more leaf-like than bracteoles. *Bracteoles* overlapping to form a tight cup round more than half to the whole of hypanthium, depressed ovate, 1.2–1.6 mm long, 1.4–2 mm wide, green or coloured on keel, broad scarious margins entire or lacinate. *Flowers* 1 or 2 terminating each branchlet, 7–9 mm diam. *Hypanthium* c. 1.5 mm long; adnate portion broadly hemispheric to broadly obconic, green, pitted; free portion flared to c. 3 mm diam., often reddish or purple-tinged. *Sepals* broadly to depressed ovate, 1–1.3 mm long, up to c. 2 mm wide; keel herbaceous, very prominent, reddish; margins whitish, scarious, minutely lacinate. *Petals* 2.5–3.3 mm long, pink, entire or crenulate, deciduous in fruit. *Androeceum* of usually 20–25 stamens; antipetalous filaments 1.3–1.9 mm long; anthers 0.25–0.35 mm long. *Ovary* 4- or 5-locular; ovules 2 per loculus, superposed. *Style* c. 1.6 mm long; stigma 0.1–0.2 mm wide. *Fruit* depressed obovoid, not seen at maturity but apparently becoming very hard (ossified), the largest examined 2.2–2.4 mm long, c. 2.7–3 mm diam., partially reddish; hypanthium with numerous tubercles and small pits or just with pits. *Seeds* not seen.

*Other specimens examined.* WESTERNAUSTRALIA [precise localities withheld]: Kalbarri National Park, Aug. 1982, *D.R. & B. Bellairs* 1653A (PERTH); Kalbarri National Park, 13 Aug. 1988, *D.R. & B. Bellairs* 911A (PERTH); Kalbarri National Park, 21 Sep. 2001, *D.R. & B. Bellairs* 6204 (PERTH); lower Muchison River [Kalbarri], 21 Aug. 1961, *C.A. Gardner* 13271 (PERTH).

*Distribution and habitat.* Known only from Kalbarri National Park, in the north of the South West Botanical Province: GS. Recorded in yellow sand over sandstone in dense heath and in sand with gravel on sandplain. (Figure 4B)

*Phenology.* Flowers recorded mid August to late September, with young fruits in late September. Fruits measured on *D.R. & B. Bellairs* 6204.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority Two. Apparently very restricted in distribution, but appears to be adequately protected as the few known populations occur in a large national park. Several recent attempts to relocate this species have failed, however, and further survey is required to determine its range.

*Etymology.* From the Latin *cristatus* – crested or ridged, referring to the prominently ridged sepals.

*Affinities.* Very closely related to *Enekbatus bounites* and *E. sessilis* but distinguished by its longer leaves and shorter petals and possibly tending also to have denser and more tuberculate patterning on the hypanthium in fruit.

*Notes.* This taxon occurs at the extreme north-west end of the range of the genus. It has more prominently keeled sepals than usual in the genus, and has the longest leaves so far recorded. The most mature fruits examined were prominently rugose, being tuberculate as well as pitted, but a smaller fruit examined was just pitted. More fruits are needed to investigate this further and obtain mature seeds to check the taxonomic status of this taxon, which appears from the few available specimens to be a distinct species.

A collection by *C.A. Gardner* 13271 includes an illustration above which an attached separate piece of paper records the ovule number as six per loculus and the stamen number as about 18. As the ovule number on this specimen is two per loculus and the stamen number for two flowers has been recorded as 23 and 25 respectively, perhaps the small attached piece should have been placed on a different specimen. The illustration does appear to match the specimen.

***Enekbatus cryptandroides* (F.Muell.) Trudgen & Rye, *comb. nov.***

*Baeckea cryptandroides* F.Muell., *Fragm.* 10, 29–30 (1876). *Type citation:* between Victoria Spring and Ularing, Young. *Type:* near Ularing [Ularring, Western Australia], 10–15 October 1875, *J. Young s.n. (holo: MEL 72683; iso: MEL 72679).*

*Illustrations.* Blackall & Grieve (1980: 80) [as *Baeckea cryptandroides*]; drawings on *C.A. Gardner* 2085.

*Shrub* 0.2–0.7 m high, often dense; lateral branchlets mostly 1–5 mm long; flower galls often present. *Petioles* 0.1–0.4 mm. *Leaf blades* narrowly obovate to oblong in outline, 2–3.5 mm long, 0.5–0.8 mm wide, 0.5–0.7 mm thick, obtuse, entire; abaxial surface with 4–7 oil glands in each row,



the oil glands very prominent in most specimens; adaxial surface flat to slightly concave. *Bracts* 1 or 2, ovate, 0.8–1.3 mm long, 0.5–2 mm wide, acuminate. *Bracteoles* semi-circular, 1–2 mm long, 1.3–2.5 mm wide, overlapping to form a cup covering c. 1/2 of the hypanthium, thin, petaline, sometimes shiny, edges entire to shallowly lacinate. *Flowers* 1(2) and terminal on the branchlets, 7–10 mm diam. *Hypanthium* 1.5–2.5 mm long, dark greenish red to red-purple or red-brown, the free portion sometimes more reddish than the adnate portion; adnate portion broadly to narrowly semi-ellipsoid or obconic, longer than free portion, minutely or distinctly tuberculate; free portion flared to 1.7–3.2 mm diam. *Sepals* semi-circular to semi-elliptic, 0.8–2 mm long, 1–2.4 mm wide; keel herbaceous, red-brown and sometimes with prominent glands; margins scarious, white, sometimes shallowly lacinate, closing inwards in fruit. *Petals* 3–4.5 mm long, often fairly deep pink in bud, usually pale pink at maturity, possibly sometimes white, margin crenate or crenulate, deciduous in fruit. *Androecium* of usually 10–12 stamens but up to 14; antipetalous filaments 0.9–1.5 mm long; anthers 0.3–0.5 mm long. *Ovary* 3-locular; placentas near top of loculus; ovules 2 per loculus, collateral. *Style* 1.3–2.2 mm long; stigma 0.2–0.3 mm wide. *Fruit* more or less obovoid with apex sunken well below the top of the free tube of the hypanthium, 5–8 mm long, c. 4 mm diam.; hypanthium tuberculate. *Seeds* not seen at maturity, but immature seeds apparently with a brownish scurfy layer adherent to their outer surface as in *E. clavifolius*. (Figure 3E–G)

*Specimens examined* (north-western area). WESTERN AUSTRALIA: 5 miles [8 km] N of Youanmi Downs Homestead, 8 Sep. 1973, *J.S. Beard* 6474 (NSW, PERTH); 19 miles [30 km] W of Sandstone, 12 Sep. 1966, *A.S. George* 7989 (PERTH); 14 miles [21 km] W of Sandstone, 17 Oct. 1972, *R.D. Royce* 10476 (PERTH).

*Other specimens examined* (south-eastern area). WESTERN AUSTRALIA: between Callion and Musson's Soak, W of Goongarrie, 10 Sep. 1970, *J.S. Beard* 6252 (NSW, PERTH); 24.5 km SSE of Sunday Bore, Perrinvale Station, 7 Sep. 1988, *R.J. Cranfield* 7136 (PERTH); 12 km SSW of Sunday Bore, Perrinvale Station, 7 Sep. 1988, *R.J. Cranfield* 7144 (PERTH); 13 km SSE of Perrinvale Homestead, 8 Sep. 1988, *R.J. Cranfield* 7173 (PERTH); Comet Vale, 9 Sep. 1927, *C.A. Gardner* 2085 (PERTH); proposed extension of Goongarrie National Park, 13 Sep. 1991, *D. McMillan & A. Chapman* 38/92 (PERTH); 3 km NE of Comet Vale townsite and 1.5 km NW of the edge of Lake Goongarrie, 10 Oct. 1980, *A.V. Milewski* 1060 (PERTH); Kurnalpi, Oct. 1980, *A.V. Milewski s.n.* (PERTH); 49 km on the roads between Pinjin and Bulong, 30°29'S, 122°24'E, 14 Oct. 1992, *L. Sweedman* S 2269 (PERTH).

*Distribution and habitat*. Occurs in the Eremaean Botanical Province, extending from near Sandstone south-east to Kurnalpi (east of Kalgoorlie): MUR. Recorded in yellow or brown clayey sand or red sand, in sandheath, open woodland and scrub. (Figure 4A)

*Phenology*. Flowers: early September to October. Fruits recorded in mid October.

*Conservation status*. This taxon has a fairly wide distribution and is not considered to be at risk.

*Affinities*. The morphological differences between this species and its close relative *Enekbatus clavifolius* are listed under the latter.

*Notes*. *Enekbatus cryptandroides* has a large geographic range and is quite variable, with north-western specimens tending to have larger leaves and flowers and more stamens than the south-eastern ones. The hypanthium may be minutely or fairly coarsely tuberculate. A specimen from the Callion area (*J.S. Beard* 6252) seems unusual in its very papillose disc.

No good fruiting material has been seen for this species but it appears that the bracteoles may occasionally be shed before the fruit reaches maturity. According to the protologue, there are one or two seeds per loculus, as in *Enekbatus clavifolius*. The fruits of *E. cryptandroides* appear, from the little material available, to be the largest in the genus and its leaves tend to be the thickest in the genus.

***Enekbatus dualis* Trudgen & Rye, *sp. nov.***

Differt ab *Enekbato sessili* staminibus paucioribus, petalis brevioribus, ovario 3-loculari, ab *E. stowardii* hypanthio pustulato ovulis superpositis, ab ambobus in bracteolis tantum 2 ornato.

*Typus*: east of Mullewa, Western Australia [precise locality withheld for conservation reasons], 4 July 1976, M.E. Trudgen 1688 (*holo*: PERTH 06229735; *iso*: AD, CANB, K, MEL, NSW).

*Enekbatus roseus* Trudgen & Rye ms.

Low dense *shrub*, 0.3–0.75 m high, commonly 0.8–2 m diam.; lateral branchlets mostly 0.5–3 mm long; flower galls absent. *Petioles* 0.1–0.3 mm long. *Leaf blades* slightly incurved, narrowly obovate to more or less oblong in outline, 0.8–2.3 mm long, 0.3–0.5 mm wide, 0.3–0.4 mm thick, obtuse (the broadly obtuse apex sometimes with a minute mucro), entire, medium green throughout to largely reddish, the red colouration most pronounced on apex and often along abaxial surface; abaxial surface usually with 2–6 prominent oil glands in each row. *Bracts* absent. *Bracteoles* not encircling hypanthium, ovate to very broadly ovate and somewhat folded, 0.6–1.2 mm long, 0.4–1 mm wide, usually obtuse, with a thickened reddish incurved keel and thin clear-hyaline border that is much broader at the base than around the apex, entire, persistent on young fruit but shed before fruit reaches maturity. *Flowers* commonly either 2 opposite and subterminal or solitary on the branchlets, 5.5–7.5 mm diam. *Hypanthium* c. 1.5 mm long; adnate portion obconic, dark green to deep red-purple, pustulate, the pustules often much paler but sometimes dark; free portion flared to 1.5–2.2 mm diam., often partially or fully coloured deep red-purple. *Sepals* broadly to shallowly triangular, 0.4–0.7 mm long, 0.6–1.1 mm wide, acute, closing inwards in fruit; keel herbaceous, reddish, thickened, incurved; margins petaloid, entire. *Petals* 2.2–2.7 mm long, deep pink or pink-purple, crenulate to entire, deciduous in fruit. *Androecium* of 12–15 stamens; antipetalous filaments 1–1.5 mm long; anthers c. 0.3 mm long. *Ovary* 3-locular; placentas about half way up loculus; ovules 2 per loculus, superposed. *Style* 1–1.5 mm long; stigma up to 0.2 mm wide. *Fruit* very broadly or depressed obovoid, 2.2–3.5 mm long, 2.5–3.2 mm diam., very hard (ossified) and with the loculi partially divided transversely by a hard septum into 2 compartments one above the other, 1- or 2-seeded as far as known; hypanthium somewhat irregularly tuberculate at first but becoming smooth. *Seeds* broadly reniform to broadly obovoid, 1.2–1.5 mm long, 0.8–1.1 mm thick and almost as wide; testa thicker than in other members of the genus, deeply colliculate or shallowly tuberculate, pale to golden brown, with no adherent layer. (Figures 1B, C & 3H–M)

*Selected specimens examined*. WESTERN AUSTRALIA [precise localities withheld]: Pindar, 29 Aug. 1964, A.M. Ashby 1059 (AD, PERTH); Pindar, 16 Aug. 1967, A.M. Ashby 2229 (AD, PERTH); Pindar, 10 Aug. 1967, J.S. Beard 4969 (KPBG); between Mullewa and Geraldton, June 1963, Y. Chadwick 1713 (PERTH); on the Mullewa to Yalgoo road, 6 Aug. 1969, H. Demarz D1456 (KPBG); Mullewa, 18 Aug. 2005, J. Docherty 352 (PERTH); no locality or date, C.A. Gardner 13345 (PERTH); Pindar, 25 Aug. 1957, J.W. Green 1578 (PERTH); Ninghan Station, 2 Aug. 2000, M. Hislop 2084 (PERTH); ESE of Mullewa, 13 Aug. 1999, G.J. Keighery & N. Gibson 2919 (PERTH); E of Pindar, 21 July 1994, S. Patrick 1905 (PERTH); E of Mullewa, 6 Aug. 1994, S. Patrick 1943 (PERTH); Pindar, 6 Oct. 1994,

*S. Patrick* 2058 (PERTH); E of Mullewa, 7 July 1995, *S. Patrick* 2329 (PERTH); Mellenbye Station, 17 Aug. 1993, *A.L. Payne* 3787 (PERTH); Pindar, 20 Sep. 1968, *M.E. Phillips* WA/68 1380 (CBG, NSW, PERTH); E of Pinjar, 9 Sep. 2003, *B.L. Rye* 239052 & *M.E. Trudgen* (CANB, K, PERTH).

*Distribution and habitat.* Occurs mainly in the Eremaean Botanical Province but extends into the South West Botanical Province, occurring from near Mullewa east to near Wurarga and south to Mellenbye Station: AW, YAL. Occurs in soil pockes in granite or laterite and in deeper soils of varied kinds, commonly recorded with *Acacia*, sometimes also with mallee eucalypts or *Melaleuca uncinata*. (Figure 4A)

*Phenology.* Flowers: June to late August. Fruits: recorded in September and October. From the few mature fruits examined it appears that the fruits are commonly 1- or 2-seeded; when they are 2-seeded the seeds may be produced in the same locus or in different loculi.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority Three. Recorded probably from more than five localities extending over a range of at least 70 km. The species appears to be locally common (*S. Patrick* pers. comm.), with at least one population recorded as having 1000 plants.

*Etymology.* From the Latin *dualis* – of two, referring to the presence of only two small bracteoles subtending each flower in this species and also the common occurrence of two flowers together on a branchlet.

*Affinities.* The affinities of this very distinctive species are not clear. *Enekbatus sessilis* is similar to it in having small narrow leaves, a pitted hypanthium and superposed ovules, but can readily be distinguished by the presence of one or more small bracts, its larger bracteoles and its 4- or 5-locular ovary.

*Notes.* *Enekbatus dualis* has the narrowest leaves and smallest flowers in the genus and the greatest tendency for divaricate branching. It appears that populations growing in soil pockets on exposed rock tend to be divaricately branched and non-layering while those on deeper soil tend to be more acutely branched and layering, but more observations are needed to confirm this.

Having bracteoles that tend to be longer than wide and do not encircle the hypanthium differentiates this species from all other members of the genus and, in this respect *Enekbatus dualis* is similar to most members of other genera in the reniform-seeded group. It also shows the greatest similarity to those genera in its seed shape and the presence of a somewhat thicker, deeply colliculate or shallowly tuberculate testa, with no adherent layer, suggesting that *E. dualis* has retained some of the primitive characters for its genus.

It is also unusual in that flower galls, which are fairly common in other members of the genus, have never been observed at any of the populations sampled, although stem galls are occasionally present (e.g. *M.E. Phillips* WA/68 1380). The stem galls are almost globular, but with prominent projecting parts, and 2–4 mm in diameter.

All of these unusual characters suggest that *Enekbatus dualis* is the most genetically isolated member of the genus.



***Enekbatus eremaeus* Trudgen & Rye, *sp. nov.***

Differt ab *Enekbato cryptandroide* hypanthio intra bracteolas plene incluso, textura sepalorum uniformi, petalis persistentibus, staminibus plus numerosis, fructu depresso-globulari ad apicem convexo.

*Typus*: 13 miles [21 km] north-east of Wiluna, Western Australia, 28 July 1963, *A.S. George* 5607 (*holo*: PERTH 06229727; *iso*: AD, CANB, K, MEL, NSW).

*Baeckea eremaea* C.A. Gardner ms. *Proposed type*: between Anketell and Sandstone, Western Australia, 17 August 1931, *C.A. Gardner* 2498 (PERTH).

*Baeckea eremophila* C.A. Gardner ms. *Proposed type*: between Wilson's Patch and Lake Darlot, Western Australia, 15 September 1927, *C.A. Gardner* 2166 (PERTH).

*Baeckea* aff. *cryptandroides* in J.P. Jessop, *Fl. Central Australia* 257 (1986).

*Illustrations*. Drawings on *C.A. Gardner* 2498 and *D.J. Pearson* 131.

*Shrub* 0.4–1 m high, 0.4–1 m diam.; lateral branchlets 1–8 mm long; flower galls often present. *Petioles* 0.2–0.6 mm long. *Leaf blades* narrowly oblong to obovate in outline, 1.3–3.7 mm long, 0.5–0.8 (1.1) mm wide, 0.4–0.5 mm thick, apex obtuse to truncate, with small hyaline processes (present on at least some of the leaves) near apex, often 1 on each side of apex resembling small horns with or without smaller ones present, sometimes 3 or more similar-sized ones present; abaxial surface semiterete with a midline groove, with 4–6 prominent oil glands per row; adaxial surface flat to slightly concave. *Bracts* 2, obovate to obcordate, 1.3–1.6 mm long, 1–2.2 mm wide, with a very narrowly ovate herbaceous centre that often extends past the broad lacinate petaloid edges. *Bracteoles* semi-circular, 2.1–3.5 mm long, 2.8–4.5 mm wide, overlapping to form a tight cup obscuring the hypanthium, petaloid, white, often shiny, entire. *Flowers* 1(2) and terminal on the branchlets, 7.5–10.5 mm diam. *Hypanthium* 1.6–3 mm long; adnate portion broadly hemispheric; free portion flared to 2.5–3.5 mm diam. *Sepals* semi-circular, 1.5–2.6 mm long, 1.5–2.8 mm wide, not obviously keeled, delicate and somewhat scarious, white-translucent, lacinate, fairly erect in fruit. *Petals* 3–4 mm long, medium to deep pink, crenulate, persistent in fruit. *Androecium* of 17–22 stamens; antipetalous filaments 1.3–2.2 mm long; anthers 0.35–0.4 mm long. *Ovary* 3-locular; placentas near the top of loculus; ovules 2 per loculus, collateral. *Style* 1.6–2.5 mm long; stigma 0.2–0.3 mm wide. *Fruit* hidden within the bracteoles and covering of persistent floral parts (sepals, petals, stamens and style), depressed globular, c. 2 mm long, c. 2.5 mm diam., hard, 1-seeded as far as known; hypanthium covering the basal half, paler than top half (disc) and protruding laterally beyond it where the two halves join, often whitish, prominently rugose with an irregular patterning of densely packed tubercles tending to form longitudinal ribs; upper half with numerous small pits. *Seeds* almost ellipsoid with a flattened margin adjacent to the collateral abortive seed or unfertilised ovule, 1.4–1.6 mm long, 0.8–1.2 mm wide and thick; testa orange-brown to medium brown, somewhat shiny, minutely colliculate or areolate. (Figure 2B–F)

*Selected specimens examined*. WESTERN AUSTRALIA: Anketell which is E of Mount Magnet on the Sandstone road, 13 Sep. 1968, *A.M. Ashby* 2595A (AD, PERTH); 11 miles [18 km] NW of Wonganoo Station, 13 Sep. 1973, *J.S. Beard* 6542 (NSW, PERTH); 40 km S of Doolgunna Homestead on the Diamond Well–Mooloogool road, 10 July 2007, *G. Byrne* 2742 (PERTH); Boulder, 1900, *W.D. Campbell* s.n. (PERTH); 10 km N of Sandstone, Black Range Station on southern boundary fence,

14 Sept. 2005, *V. Clarke* VTC BR 10 (PERTH); 76 km from Cue on the Cue to Cogra road, 16 Aug. 1985, *H. Demarz* 10639 (PERTH); 42.5 km S of Sandstone, 14 Aug. 2000, *M. Hancock* 859 (NSW, PERTH); Victoria Desert Camp 57 [30° 06' S, 123° 54' E], Elder Exploring Expedition, 20 Sep. 1891, *R. Helms s.n.* (AD, MEL, NSW); 30 km W of Yeelirrie Homestead, 14 Aug. 1982, *A.A. Mitchell* 1011 (PERTH); 3.2 km E of Brealya Well, N of Cogra Downs Station on Nallan–Sandstone road, 22 June 1995, *S. Patrick* 2277 (PERTH); 7.5 km NW of Streich Mound, Queen Victoria Spring Nature Reserve, 28 Oct. 1992, *J.D. Pearson* 2935 (PERTH); 14 miles [21 km] SE of Murchison Downs Station, along the Rabbit Proof Fence, 28 Aug. 1958, *N.H. Speck* 1310 (AD, CANB, NSW, PERTH); 25 km S of the Agnew turnoff on the Leonora to Leinster road, 10 Oct. 1984, *C. I. Stacey* 757 (PERTH); Erliston Station, Laverton, 18 Aug. 1995, *D. True* OS 92 (PERTH); 40 km NE of Bandyu Homestead which is 100 km N of Laverton, 27 Aug. 1968, *Paul G. Wilson* 7356 (AD, PERTH).

*Distribution and habitat.* Distributed in the south-western part of the Eremaean Botanical Province and in the South-western Interzone: COO, GVD, MUR. Recorded from Diamond Well Station south to Boulder and from near Meekatharra east to Rason Lake. The Boulder record is based on a single old collection and might either be a vague locality or an outlier as there have been no other collections from that vicinity. *Enekbatus eremaeus* is most commonly found on red sand in spinifex sandplain but also occurs in low open woodland with *Eucalyptus gongylocarpa* and spinifex and amongst herbs on yellow sand in dune swales. (Figure 4B)

*Phenology.* Flowers: July to October. Mature fruits: late October to late November. Mature fruits observed on *J.D. Pearson* 131 (1 only) and *J.D. Pearson* 2935 (many fruits).

*Conservation status.* This species is the most common and widely distributed member of the genus.

*Etymology.* The specific epithet alludes to the occurrence of this species in the Eremaean. It extends inland almost to the centre of the State.

*Affinities.* *Enekbatus eremaeus*, and apparently also its closest relative *E. longistylus*, differ from other members of the genus in having petals persistent as well as sepals at the summit of the mature fruit, which is completely hidden from view. The other species lose the petals and tend to also lose the stamens and/or style later.

*Enekbatus longistylus* occurs in a less arid region and differs in its shorter, broader leaves with hyaline processes extending along the margins, longer stamens in comparison with the sepal and petal length, and longer style.

*Notes.* This is one of the two species of *Enekbatus* with an entirely Eremaean distribution and it extends much further inland than the other species. Gardner apparently first intended to name this new species *Baeckea eremophila* based on one of his specimens collected in 1927, but in the 1930s he opted for a different name with a similar meaning, *Baeckea eremaea*. In choosing an epithet for this species, we have adopted the latter of Gardner's names since this was used for several specimens. A brief description of the species was given in *Flora of Central Australia* (George & Trudgen 1981) as *Baeckea aff. cryptandroides*.

The fruits of this species and its closest relative, *Enekbatus longistylus*, appear to be smaller than in other members of the genus, with thin walls between the loculi, but are still very hard at maturity and are more difficult to cut open than those of *E. clavifolius*, perhaps partly because of their more

spherical shape. Their complete covering by the glossy bracteoles and persistent floral parts may also play a role in protecting the seeds from insect attack. Despite the large number of collections of this species, mature fruits are scarcely known and more fruiting material is certainly needed.

***Enekbatus longistylus* Trudgen & Rye, *sp. nov.***

A *Enekbato eremaeo* affinis sed foliis latioribus atque brevioribus marginibus magis fimbriatis, staminibus et stylo longioribus differt.

*Typus*: Perenjori area, Western Australia [precise locality withheld for conservation reasons], 11 September 2003, B.L. Rye 239083 & M.E. Trudgen (*holo*: PERTH 06764487; *iso*: CANB, K, MEL, NSW).

*Shrub* 0.2–1 m high, commonly 0.8–1 m across; lateral branchlets mostly 0.5–4 mm long; flower galls often present. *Petioles* 0.1–0.3 mm long. *Leaf blades* obovate or oblong to almost circular in outline, 0.8–1.5 mm long, 0.6–1.3 mm wide, 0.2–0.4 mm thick, truncate, the keel often forming a prominent subterminal abaxial swelling, the margins with small hyaline rim and shortly fringed with slender hyaline processes; abaxial surface with prominent oil glands usually 3 or 4 per row. Bracts 2, more or less entire, broadly to depressed ovate, 1.1–2 mm long, 1.3–2.5 mm wide, with thick brown keel sometimes/often extending beyond the broad petaloid edges. *Bracteoles* depressed ovate, 1.8–2.5 mm long, 3.6–4.6 mm wide (when flattened), greatly overlapping to form a tight cup obscuring the hypanthium, petaloid, white, shiny. *Flowers* 1(2) and terminal on the branchlets, 7–10.5 mm diam. *Hypanthium* 1.4–2.2 mm long; adnate portion broadly obconic to shallowly cup-shaped; free portion flared to 2–3.5 mm diam. *Sepals* broadly or very broadly ovate, 1.2–2.1 mm long, 1.5–2.5 mm wide, scarious, not obviously keeled, shiny white as for bracteoles, more or less entire. *Petals* 3–5 mm long, pale to medium pink, crenate, closing to erect in older flowers, apparently persistent in fruit. *Androecium* of 19–24 stamens; antipetalous filaments 2.5–3 mm long; anthers c. 0.4 mm long. *Ovary* 3-locular; placentas near top of loculus; ovules 2 per loculus, collateral. *Style* 2.8–3.6 mm long; stigma 0.15–0.2 mm diam. *Fruit* hidden within the bracteoles and covering of persistent floral parts (sepals, petals, stamens and style), not seen at maturity, the largest seen depressed ovoid and c. 1.6 x 2.3 mm, hard, apparently 1-seeded; hypanthium apparently shorter than upper part (disc) but protruding laterally beyond it where the two parts join, both parts fairly smooth. (Figure 2G,H)

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*Selected specimens examined*. WESTERN AUSTRALIA [precise localities withheld]: E of Perenjori, Sep. 1934, E.M. Barker 30 (PERTH); E of Tardun, 27 Sep. 1973, J.S. Beard 6699 (NSW, PERTH); Koolanooka, 19 Sep. 1931, C.A. Gardner 2681 (NSW, PERTH); Perenjori, Nov. 1953, C.A. Gardner 12157 (AD, PERTH); S of Morawa, 2 Oct. 1962, F. Lullfitz L1615 (PERTH); S of Morawa, 2 Oct. 1962, M.E. Phillips WA/62 1720 (CBG, NSW, PERTH); E of Perenjori, 11 Sep. 2003, B.L. Rye 231014 & M.E. Trudgen (CANB, K, PERTH); E of Perenjori, 11 Sep. 2003, B.L. Rye 231015 & M.E. Trudgen (AD, PERTH).

*Distribution and habitat*. Endemic to the South West Botanical Province, extending from near Tardun south-east to the Perenjori area: AW. Most commonly found in sandplain, often on yellow sand in *Acacia*- and *Melaleuca*-dominated vegetation. The type locality had dull brownish yellow silty fine sand, with *Acacia* high open scrub to high shrubland over *Melaleuca* high shrubland over *Ecdeiocolea* open sedgeland over *Borya* open herbland and annual Asteraceae. (Figure 4B)

*Phenology*. Flowers September to October. Immature fruits recorded in early October.



*Conservation status.* Conservation Codes for Western Australian Flora: Priority Three. Recorded from at least five localities over a range of *c.* 100 km. Not known from any conservation reserves.

*Etymology.* The specific epithet, derived from two Latin words, refers to the long style of this species.

*Affinities.* See notes under its closest relative, *Enekbatus eremaeus*.

*Notes.* This is a very distinctive species that can be identified by its leaves alone. It has longer stamens and a longer style than all other members of the genus. Good fruiting material is still needed. Leafy galls are sometimes present on the specimens; these are bright red at first, becoming dark grey with age.

***Enekbatus planifolius* Trudgen & Rye, *sp. nov.***

Ab *Enekbato stowardii* affinis sed foliis latioribus et planioribus et ovario 2- vel 3-loculari differt.

*Typus:* north of Morawa, Western Australia [precise locality withheld for conservation reasons], 9 September 2003, *B.L. Rye* 239042 & *M.E. Trudgen* (*holo:* PERTH 07536798; *iso:* MEL, NSW).

*Shrub* 0.4–1.1 m high, commonly 0.8–1.2 m diam., with multiple branches from the base; lateral branchlets mostly 1–8 mm long; flower galls often present. *Petioles* 0.3–0.6 mm long. *Leaf blades* narrowly obovate, 3.5–4.5 mm long, 1.1–1.4 mm wide, 0.1–0.3 mm thick, obtuse, entire; abaxial surface with usually 3–5 prominent oil glands per row. *Bracts* usually solitary, broadly ovate, shorter and more keeled than the bracteoles. *Bracteoles* 2, entire, often partially reddish especially on the keel, overlapping to form a cup concealing the anthopodium but only *c.* 1/4 of the hypanthium, very broadly or depressed ovate, 1.2–1.5 mm long, up to 1.6 mm wide, rather prominently keeled, margins pale yellow-green, firm (not scarious), entire. *Flowers* 1 or 2 terminating each branchlet or in each axil, 7–8 mm diam. *Anthopodium* often visible, up to 0.5 mm long. *Hypanthium* *c.* 2.5 mm long; adnate portion obconic, pitted, green; free portion flared to 2–2.5 mm diam., deep red-purple. *Sepals* very broadly or depressed ovate, 0.7–1.2 mm long, usually 1–1.3 mm wide; keel reddish; margins whitish, entire. *Petals* 2–3 mm long, medium to deep pink or purplish pink, deciduous in fruit. *Androecium* of 13–15 stamens; antipetalous filaments *c.* 1.3 mm long, darker pink and much broader at the base than the other filaments; anthers *c.* 0.25 mm long, dull yellow-green with a pale green gland. *Ovary* 2- or 3-locular; ovules 2 per loculus, collateral. *Style* 1.3–1.5 mm long, pink; stigma *c.* 0.15 mm wide, yellowish. *Fruit* obovoid, 2–2.5 mm long, 1.5–1.8 mm wide, summit convex, toughly fibrous, 1- or 2-seeded; hypanthium appearing smooth but with numerous minute pits. *Seeds* irregularly obovoid, 1.3–1.5 mm long, 0.7–0.9 mm wide, often not as thick as wide; testa becoming orange-brown, minutely colliculate and with a much larger pattern of shallow circular depressions superimposed on the very numerous colliculae, with no adherent layer. (Figure 1D)

*Other specimens examined.* WESTERN AUSTRALIA [precise localities withheld]; type locality, 13 Oct. 2003, *B.L. Rye* 231002 & *M.E. Trudgen* (CANB, K, PERTH); type locality, 13 Oct. 2003, *B.L. Rye* 231001 & 231003 & *M.E. Trudgen* (PERTH); SE of type locality, 13 Oct. 2003, *B.L. Rye* 231004 & *M.E. Trudgen* (PERTH); W of type locality, 13 Oct. 2003, *B.L. Rye* 231009 & *M.E. Trudgen* (AD, BRI, PERTH).

*Distribution and habitat.* Occurs in the South West Botanical Province, known from a very small area north of Morawa: AW. Occurs mainly in brown silty fine sand, possibly over lateritic gravel, in *Acacia-Melaleuca* open scrub, also recorded in a more saline area with mallees. (Figure 4A)

*Phenology.* Flowers recorded from early September to early October, with mature fruits in October.

*Conservation status.* Conservation Codes for Western Australian Flora: Priority One. This species appears to be very geographically restricted and is known from one large population estimated to contain several thousand plants and another nearby population that is much smaller.

*Etymology.* From the Latin *planus* – flat and *folium* – leaf, this species having flatter leaves than any other member of the genus.

*Affinities.* Very closely related to *Enekbatus stowardii*, being similar particularly in its bracteoles, hypanthium and seed testa, but that species can be distinguished by its narrower leaves, and its 3- or 4-locular ovary. The two taxa are geographically distinct, with *E. planifolius* occurring just north-west of the range of *E. stowardii*.

*Notes.* In this recently discovered taxon, all or a good proportion of the flowers have a 2-locular ovary, and there is an anthopodium up to 0.5 mm long. Other members of the genus have a 3–5-locular ovary and their flowers are fully sessile or on an anthopodium up to 0.35 mm long. The reduced number of loculi in *E. planifolius* may be responsible for its seeds tending to be broader than thick rather than thicker than broad.

***Enekbatus sessilis* Trudgen & Rye, *sp. nov.***

Bracteolae pro parte maxima hypanthii occultae. Corolla in fructu descidua. Stamina 16–25. Ovarium 4- vel 5-loculare; ovula 2 per loculum, superposita. Fructus depresso-obovoideus, lignosus, foveolatus. Semina testa subcrustacea, colliculata, brunnea.

*Typus:* Great Northern Hwy, 14.1 km N of Wubin, Western Australia, 30 August 1975, *M.E. Trudgen* 1416 (*holo:* PERTH 06229743; *iso:* AD, CANB, K, MEL, NSW).

*Illustration.* Drawings on *W.E. Blackall* 2795.

*Shrub* often low or domed, 0.3–0.6(1.2) m high, commonly 0.5–1.2 m diam.; lateral branchlets 0.5–1.5 mm long; flower galls often present. *Petioles* 0.1–0.2 mm long. *Leaf blades* narrowly oblong to almost ovate in outline, mostly 1–2 mm long (rarely with some longer leaves up to 3.5 mm present as well), 0.4–0.6 mm wide, 0.3–0.4 mm thick, obtuse, entire; abaxial surface with midline groove, mostly with 3–6 prominent oil glands per row. *Bracts* 1 or 2, narrowly ovate to ovate with acuminate apex or more leaf-like, commonly 0.5–2 mm long, 0.8–2 mm wide. *Bracteoles* overlapping to form a tight cup round 2/3 to the whole (usually *c.* 3/4) of hypanthium, semi-circular, 1.3–2.2 mm long, 1.6–3 mm wide, thin, green or white, margins entire or minutely laciniate. *Flowers* 1(2) and terminal on the branchlets, 8–11 mm diam. *Hypanthium* 1–2 mm long; adnate portion broadly hemispheric to broadly obconic, green, pitted; free portion flared to 2–3 mm diam., often reddish or purple-tinged. *Sepals* broadly to depressed ovate, 0.8–1.5 mm long, 1.2–3 mm wide; keel herbaceous, pink to maroon or red-brown and pitted at base; margins white, scarious, entire or minutely laciniate. *Petals* 2.5–4.5 mm long, very pale to medium pink or purplish pink, entire or crenulate, deciduous in fruit. *Androecium*

of 16–25 stamens, usually 20 or 21; antipetalous filaments 1.1–1.6 mm long, white with pink base; anthers 0.25–0.35 mm long. *Ovary* 4- or 5-locular; placentas attached half way up loculus; ovules 2 per loculus, superposed. *Style* 1–1.6 mm long; stigma 0.1–0.2 mm wide. *Fruit* depressed obovoid or globular, 2.5–4 mm long, 3–4 mm diam., very hard (ossified), commonly 1- or 2-seeded; hypanthium with widely spaced to moderately dense, small pits. *Seeds* broadly obovoid or of other compact shapes, often thicker than broad, 1.1–1.4 mm long, 0.7–1.2 mm thick; testa thin, golden brown, very densely and minutely colliculate, largely covered by an adherent rugose layer. (Figures 1E & 2I–L)

*Selected specimens examined.* WESTERN AUSTRALIA: Yuna, Sep. 1930, *E. Ashby* 2608 (ADW, NSW); 6.5 km SSW of Oxley Hill along Drew Rd, which is NE of Arrino, 25 Sep. 1990, *R.J. Cranfield & P.J. Spencer* 7845 (PERTH); Wilroy railway siding, which is 18.3 km SE of Mullewa, 19 Sep. 1985, *J. D'Alonzo* 307 (PERTH); 10 km NE of Wubin, c. 0.3 km along Richards Rd from Great Northern Highway, 26 Aug. 1998, *R. Davis* 6495 (PERTH); 214 km from Mount Magnet on Geraldton road, 26 Oct. 1963, *D.W. Goodall* 1710 (PERTH); N of Peterson Rd, c. 12 km S of Wubin, 13 Sep. 1996, *M. Hislop* 496A,B (PERTH); Bunjie Siding, 26.3 km S of Perenjori, *N. Hoyle* 280 (PERTH); Canna, 3 Sep. 1926, *E.H. Ising s.n.* (AD); Wongan Hills, 14 Aug. 1982, *G.J. Keighery* 5997 (PERTH); near Moora, Aug. 1959, *F.R. Morrison s.n.* (NSW, PERTH); Ajana, 20 July 1967, *E.B.J. Smith s.n.* (PERTH); on Yammampool Rd, 6.25 km S of Catto Rd and 0.4 km N of Neates Rd, 29°16'S, 115°48'E, 8 Sep. 2003, *B.L. Rye* 239026–239028 & *M.E. Trudgen* (PERTH); 9 km E of Burakin, 31 Aug. 1975, *M.E. Trudgen* 1431 (PERTH); 2.7 km N of Wubin, 0.5 km S of Stewart Rd on Midlands Rd, 14 Oct. 2003, *B.L. Rye* 231042 & *M.E. Trudgen* (CANB, MEL, PERTH).

*Distribution and habitat.* Occurs mainly in the South West Botanical Province, extending slightly into the Eremaean Botanical Province: AW, GS, YAL. Extends from just north of the Murchison River south-east to Wongan Hills and to just east of Burakin. Found on yellow to orange-brown fine sand, sometimes over laterite or with gravel. It occurs in a variety of vegetation types including *Eucalyptus* open mallee or low woodland, and scrub of *Acacia*, *Allocasuarina* and/or *Melaleuca*, also recorded in low heath at disturbed sites. (Figure 4C)

*Phenology.* Flowers: late July to September, the northern populations beginning flowering earlier than the southern ones. Fruits recorded from mid September to October. Seeds measured from *D.W. Goodall* 1710 and *B.L. Rye* 293107 & *M.E. Trudgen*.

*Conservation status.* This species appears to be relatively common.

*Etymology.* From the Latin *sessilis* – sitting, used in the botanical sense for lacking a stalk, in reference to the sessile flowers.

*Affinities.* Very closely related to *Enekbatus bounites* and *E. cristatus*, differing as noted under those two taxa, which possibly should be regarded as subspecies of *E. sessilis*.

*Enekbatus sessilis* mostly has shorter leaves less than 2 mm long and only 3–6 main oil glands in the rows closest to the midvein whereas the the other two taxa have longer leaves with 7–12 main oil glands.

*Notes.* A fairly widespread and variable species. A particularly variable population was sampled from west of Perenjori (*M.E. Trudgen* 2243A–E). To illustrate the degree of variation, specimen C had large leaves up to c. 3.5 mm long with up to 8 oil glands and large flowers with petals 4.5 mm long, whereas



specimen A had smaller leaves with fewer oil glands and small flowers with petals only 2.5 mm long, also differing in its sepals being more distinctly keeled. Despite their differences in size, all flowers sampled from both specimens were 5-locular, with the loculi located opposite the sepals.

In this species the bracteoles cover most or all of the hypanthium in flower but only a small proportion of the mature fruit. The small bracts below are usually well defined but are sometimes scarcely differentiated from the leaves, differing from the leaves directly below only in having the base somewhat broadened and flattened. While there are many specimens with immature fruits, mature fruits have very rarely been collected.

***Enekbatus stowardii* (S.Moore) Trudgen & Rye, *comb. nov.***

*Baeckea stowardii* S.Moore, *J. Linn. Soc.* 45: 176 (1920). *Type:* Cowcowing, Western Australia, 1916, F. Stoward 316 (*holo:* BM 000603462; *iso:* MEL 73053).

*Illustrations.* Blackall & Grieve (1980: 80) [*as Baeckea stowardii*]; drawings on W.E. Blackall 2847 and C.A. Gardner 2706.

*Shrub* (0.3)0.6–1.3 m high, commonly 0.6–1.2 m wide, sometimes tangled; lateral branchlets 1–5(12) mm long; flower galls often present. *Petioles* 0.1–0.3 mm long. *Leafblades* oblong to obovate in outline, 1.7–4 mm long, 0.5–0.8 mm wide, 0.35–0.6 mm thick, obtuse, entire; abaxial surface with usually 3–5 very prominent tuberculate oil glands per row. *Bracts* usually solitary, ovate or broadly ovate, 0.6–1.3 mm long, up to 1 mm wide, prominently keeled. *Bracteoles* entire, often partially reddish especially on the keel, more or less semi-circular, 1.3–1.5 mm long, 1.5–2.5 mm wide, overlapping to form a cup covering 1/4–1/3 of the hypanthium, firm (not scarious). *Flowers* 1(2) and terminal on the branchlets, 6–13 mm diam. *Hypanthium* 1.5–3 mm long; adnate portion obconic, pitted, grey-green; free portion flared to 2–3 mm diam., deep red-purple. *Sepals* depressed ovate or very depressed, 0.6–1.1 mm long, 1.3–2.2 mm wide; keel herbaceous, reddish, not prominent; margins scarious, white, lacinate. *Petals* 2–4 mm long, very pale to medium pink, crenulate, deciduous in fruit. *Androecium* of 13–19 stamens; antipetalous filaments 0.9–1.5 mm long; anthers 0.25–0.35 mm long. *Ovary* 3- or 4-locular; ovules usually 2 per loculus, collateral, rarely with 1(2) additional ovules superposed. *Style* 1–2 mm long; stigma 0.15–0.2 mm wide. *Fruit* obovoid, 2.3–4 mm long, 2–2.5 mm diam., toughly fibrous, commonly 1- or 2-seeded; hypanthium appearing smooth but with numerous minute pits. *Seeds* irregularly obovoid or broadly so to almost reniform, 1.3–1.6 mm long, 0.7–0.8 mm wide, 0.75–0.9 mm thick; testa thicker than most other species, golden brown, minutely colliculate and with a much larger pattern of shallow circular depressions superimposed on the very numerous colliculae, with no adherent layer. (Figures 1F,G & 2M–P)

*Selected specimens examined.* WESTERN AUSTRALIA: NE of Perenjori, 24 Aug. 1971, T.E.H. Aplin 4844 (PERTH); 80 km S of Wubin, 9 Aug. 1963, J.S. Beard 2584 (PERTH); 8 km NE of Mt Gibson turnoff on Wubin–Paynes Find road, 29 Aug. 1976, R. Coveny 7906 & B.R. Maslin (NSW, PERTH); Karara Station, W of shearing shed, 29° 11' S, 116° 41' E, 25 Oct. 1992, L.A. Craven, F.A. Zich & A.M. Lyne 8903 (PERTH); c. 70.7 km NE of Wubin on the Great Northern Highway, 22 Sep. 1985, J. D'Alonzo 486 (PERTH); Wubin, 5 Sep. 1959, S. de la Hunty (PERTH); Koorda, 24 Sep. C.A. Gardner 2738 (PERTH); 217 mile peg on the Paynes Find road, 20 Aug. 1973, H. Demarz 4351 (PERTH); 12 km ESE of Latham, 14 Aug. 1997, F. Keast L6D 245 (PERTH); 19.5 km SE of Spencer Rd on Rabbit Proof Fence Rd, c. 54 km SE of Perenjori, 28 July 1996, T.R. Lally 1105 & B.J. Lepschi (PERTH); Wubin, 24 Sep. 1963, J. Landy s.n. (MEL); Taylor Rd, 3 km W of Old Well Rd and 0.2 km

E of Benton Rd, E of Latham, 13 Oct. 2003, *B.L. Rye* 231028 & *M.E. Trudgen* (AD, BRI, CANB, PERTH); 1.0 km W of Martin Rd on Chisholm Rd, 29°51'S, 116°38'E, 11 Sep. 2003, *B.L. Rye* 239103 & *M.E. Trudgen* (HO, MEL, NSW, PERTH).

*Distribution and habitat.* Occurs mainly in the South West Botanical Province, extending slightly into the Eremaean Botanical Province: AW, YAL. Extends from the Perenjori area south-east to Cowcowing. Recorded mainly in gravelly or lateritic soils with some clay, in shrublands, often including *Acacia* and *Melaleuca* species, and in mallee woodlands. (Figure D)

*Phenology.* Flowers: mainly July to September. Fruits: recorded late October. Mature fruits have been observed on Craven, Zich & Lyne 9803.

*Conservation status.* The range of this species is about 200 km long and many populations have been recorded.

*Affinities.* See notes under *Enekbatus planifolius*, which is the closest relative of *E. stowardii*. Geographically, *E. stowardii* overlaps considerably with *E. sessilis* but can readily be distinguished from that species in having the ovules collateral rather than superposed.

*Notes.* The illustration of this species in Blackall & Grieve (1980: 80) shows the bracteoles covering more than normal of the hypanthium although the remainder of the illustration and the notes are accurate for *Enekbatus stowardii*. Perhaps the flower illustrated was still in bud or perhaps that part of the illustration was actually of *E. sessilis*.

Flower size is extremely variable in *E. stowardii*, with flowers ranging from 8 to 13 mm diameter observed in a single population east of Perenjori (*B.L. Rye* 23102 & *M.E. Trudgen*, *B.L. Rye* 23103 & *M.E. Trudgen*). Variation in stamen number is not as great in *E. stowardii* as in some of the other species, with most specimens having 15–17 stamens. However, this species is perhaps the most variable in its gynoeceum, with 3- and 4-locular ovaries both common and in very rare instances with superposed as well as collateral ovules.

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## The status of infraspecific taxa and new subspecies in *Ptilotus stirlingii* (Amaranthaceae)

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### Abstract

Davis, R.W. & Butcher, R. The status of infraspecific taxa and new subspecies in *Ptilotus stirlingii* (Amaranthaceae). *Nuytsia* 20: 261–270 (2010). This paper evaluated current infraspecific taxa within *Ptilotus stirlingii* (Lindl.) F.Muell. using morphometric analysis. We conclude that var. *pumilus* Benl should no longer be recognised as a distinct variety from var. *stirlingii* and that var. *laxus* (Benth.) Benl and var. *minutus* Benl should be merged into a single taxon. The new name *P. stirlingii* subsp. *australis* R.W.Davis & R.Butcher is erected for this taxon and var. *stirlingii* is elevated in rank. With these changes, *P. stirlingii* now comprises two subspecies rather than four varieties. Revised descriptions and a key are presented for the new subspecies.

### Introduction

This paper is one of a continuing series dealing with appropriate ranks for Western Australian infraspecific taxa within *Ptilotus* R.Br., in preparation for the *Flora of Australia* treatment of Amaranthaceae. It discusses the differences between the existing varieties of *P. stirlingii* (Lindl.) F.Muell., and establishes a new name, *P. stirlingii* subsp. *australis* R.W.Davis & R.Butcher, *subsp. nov.*

Benl (1959, 1967) recognised four varieties in *Ptilotus stirlingii*: var. *stirlingii* (Lindl.) F.Muell., var. *pumilus* Benl, var. *laxus* (Benth.) Benl and var. *minutus* Benl. The varieties are distributed in two pairs within the South-west Botanical Province: var. *stirlingii* and var. *pumilus* occur in the north of this region in the area between Perth, Shark Bay and Manmanning, which is in the Avon Wheatbelt IBRA region (*Interim Biogeographic Regionalisation for Australia*; Department of Environment, Heritage, Water and the Arts 2008); var. *laxus* and var. *minutus* are distributed in the south, from the south-eastern edge of the Stirling Range eastward across the Esperance Plains IBRA region. *Ptilotus stirlingii* var. *pumilus* is currently listed as a Priority One taxon under the Western Australian Department of Environment and Conservation's (DEC) Conservation Codes for Western Australian Flora (Smith 2010). One of its two disjunct populations occurs within the distribution range of var. *stirlingii*. Across their distributions, the few populations of var. *laxus* and var. *minutus* are closely allopatric, with var. *laxus* occurring closer to the coast than var. *minutus* (Western Australian Herbarium 1998–).

The key morphological character used by Benl (1967) for separating the northern pair of varieties from the southern pair was stem and leaf indumentum. The northern pair (vars *stirlingii* and *pumilus*) are recorded as cobwebby-pubescent or woolly-tomentose, while the southern pair (vars *laxus* and *minutus*) are recorded as glabrous or glabrescent.

Benl (1967) cited two differences between var. *stirlingii* and var. *pumilus*, with the latter (described from only the holotype) having a woolly indumentum on stems and leaves and tepals 8–9 mm long and the former having a sparser indumentum and tepals to 10–12 mm long. As additional specimens have been lodged at the Western Australian Herbarium (PERTH) it has become clear that these differences are not consistent. Indumentum grades subtly from sparsely hairy to woolly among all northern specimens and tepal length has now been found to vary continuously from (7.2–)8–14 mm. These differences appear to be influenced by environmental factors, with plants in drier habitats tending to have smaller tepals and woollier indumentum.

Benl (1967) regarded var. *minutus* and var. *laxus* as differing from each other in leaf shape and flower number, with var. *minutus* having narrowly elliptic leaves and 8–12 flowers per spike and var. *laxus* having broadly cuneate to obovate leaves and 15–20 flowers per spike. Again, these characters have now been found to vary continuously among southern specimens of *P. stirlingii*, and gradation in leaf shape from elliptic to obovate is observable on some individual specimens (e.g. PERTH 07256361). Interestingly, the holotype of var. *minutus* (in early flower) clearly has more than 12 flowers per spike.

In summary, revisionary study of *Ptilotus stirlingii* has determined that the characters used to distinguish the pairs of varieties are continuous in nature. As such, recently collected specimens are difficult to place under the existing taxonomy. A morphometric analysis of *P. stirlingii* was therefore undertaken to test the robustness of Benl's taxonomy.

## Methods

Ten characters (six continuous quantitative characters, two quantitative ratio characters and two qualitative binary/multistate characters; Table 1) were measured for 50 specimens of *Ptilotus stirlingii* held at PERTH. These comprised two specimens of var. *laxus* (of three held at PERTH), two specimens of var. *pumilus* (of two), four specimens of var. *minutus* (of four; one originally identified as *P. aff. stirlingii*) and 35 specimens of var. *stirlingii* (of 55; one originally identified as *P. aff. stirlingii*, six originally identified as var. *indet.*). Type material of var. *minutus* is held at PERTH but was not included in the analysis as the spikes are immature. All characters were measured from herbarium specimens. Voucher specimen details are presented in Table 2.

Five measurements were made per character with the mean used in morphometric analysis. Characters were selected to include those used by Benl to separate the varieties of *P. stirlingii* (i.e. tepal length, leaf shape and indumentum of stems and leaves) and to include others found by the first author to be generally reliable for discriminating taxa within the genus (i.e. style, bract and bracteole length). Number of flowers per inflorescence (used by Benl to separate var. *laxus* and var. *minutus*) was not used as it was difficult to count accurately and is highly variable on individual specimens due to the indeterminate growth of the spike axis (the majority of PERTH specimens lacked fully mature spikes). *Ptilotus stirlingii* differs in this regard from few-flowered species such as *P. beardii* Benl and *P. rigidus* Lally. Spike length (and therefore flower number) in *P. stirlingii* has also been observed to be affected by growing conditions. Indumentum was assessed using a dissecting microscope and subjectively coded to reflect the variation observed. Habit was coded from specimen label data and/or by interpretation of the specimen itself.



**Table 1.** Characters used in the morphometric analysis of *Ptilotus stirlingii* and character codes used in the NMDS ordination.

Quantitative characters	Code
1. Bract length (mm):	BL
2. Bracteole length (mm):	BrL
3. Tepal length (mm):	TL
4. Style length (mm):	SL
5. Leaf length (mm):	LL
6. Leaf width (mm):	LW
7. Leaf length:width (ratio):	LL/LW
8. Widest point of the leaf relative to total length (ratio):	DW/LL
Qualitative characters	
1. Indumentum of stems and leaves: 0 – very sparse, 1 – sparse, 2 – moderate, 3 – woolly, 4 – densely woolly	IND
2. Habit: 0 – prostrate, 1 – sprawling to decumbent	HAB

The resulting data matrix was analysed phenetically using the software package Primer 6 (v. 6.1.13) (Clarke & Gorley 2006). The Gower metric (Gower 1971) was used to create a resemblance matrix, as it is suitable for use with datasets containing a mixture of qualitative and quantitative characters (Crisp & Weston 1993; Flann *et al.* 2008). The unweighted pair-group method of arithmetic averages (UPGMA) was used to create a dendrogram of hierarchically clustered individuals from this association matrix. This matrix was also used to derive an ordination using non-metric multidimensional scaling (NMDS). The ordination was run 100 times using random starting configurations and the result having the lowest Kruskal stress value in two- and three-dimensional space retrieved. Spearman rank correlation coefficients were calculated to assess the relative contribution of each character to the ordination.

Results

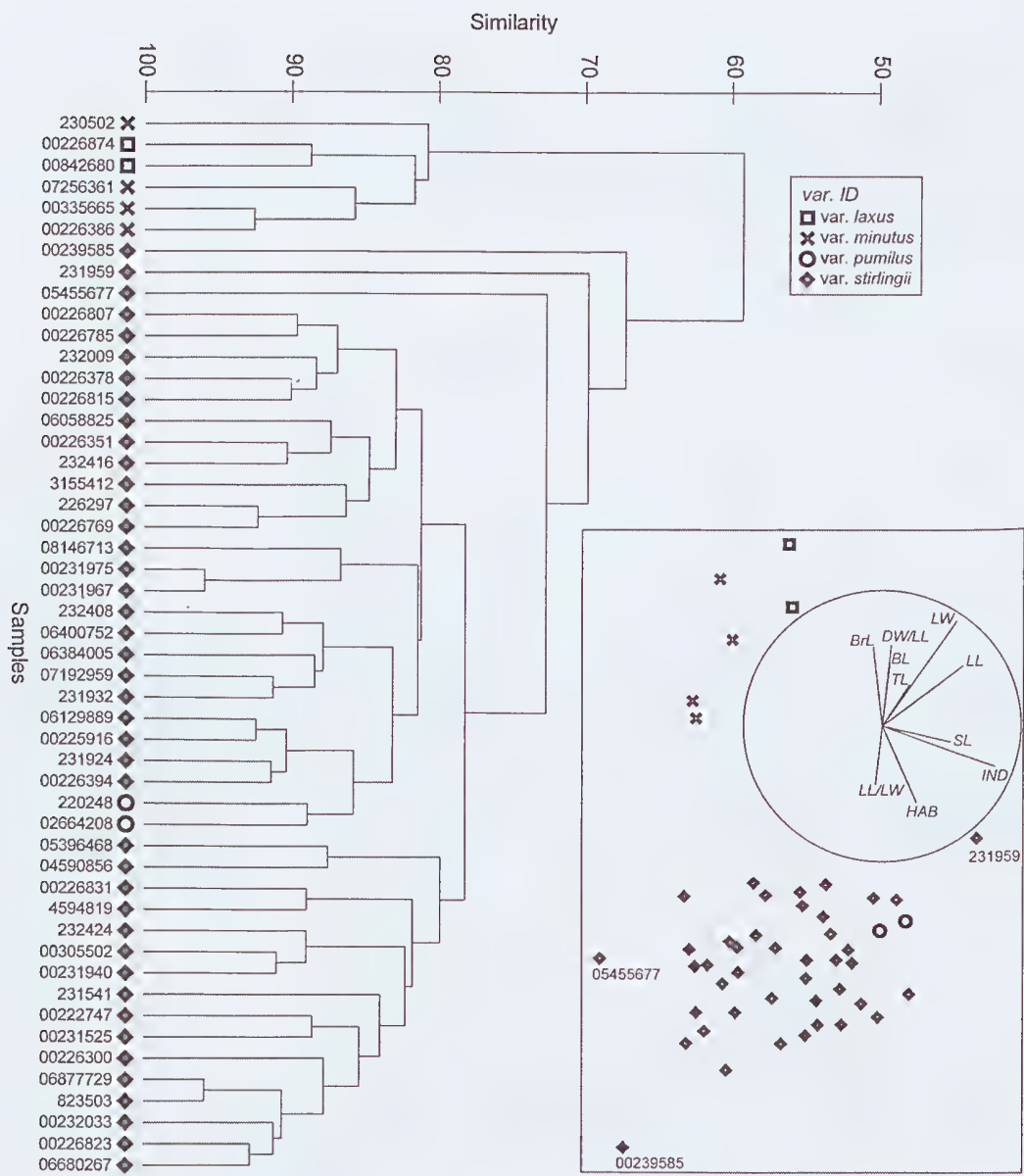
Cluster analysis of the *Ptilotus stirlingii* dataset identified two main groups: the first consisted of the two samples of var. *laxus* and the four samples of var. *minutus* united at a similarity level of *c.* 81, while the second contained the two samples of var. *pumilus* and all the samples of var. *stirlingii* united at a similarity level of *c.* 67. The two groups were united at a similarity level of *c.* 59 (Figure 1). The same associations between the varieties were recovered in the two- and three-dimensional NMDS ordinations (Figure 1; three-dimensional ordination not shown), where there is a clear separation between the samples of vars *pumilus*+*stirlingii* from vars *laxus*+*minutus*. Kruskal stress values for the ordinations were 0.17 for the two-dimensional space and 0.11 for the three-dimensional space, indicating that a reasonably high degree of distortion of the data was required for it to fit the low number of dimensions (Quinn & Keough 2002). These stress values are still sufficiently low for the configurations between the samples to be considered a good representation of the similarity matrix (Quinn & Keough 2002). Characters contributing most to the separation between vars *laxus*+*minutus* from vars *pumilus*+*stirlingii* (Figure 1; Table 3) are bracteole length (Spearman’s *R* = -0.5856), leaf shape, as represented by the position of the widest point relative to the length (*R* = -0.5815), habit (*R* = 0.5582), bract length (-0.4596) and the leaf length:width ratio (*R* = 0.4296), while those contributing most to the spread of samples within each group are indumentum (*R* = -0.8165), leaf width (*R* = -0.7569) and leaf length (*R* = -0.5968).

**Table 2.** Voucher specimens used in the morphometric analysis of *Ptilopus stirlingii* sens. lat. indicating the variety each specimen was identified as at the time of analysis and the subspecies to which it is now assigned. PERTH sheet numbers were used to label the specimens in the analysis. Specimens marked with an asterisk (\*) had been previously identified as *P. aff. stirlingii*; specimens marked with a caret (^) had previously been identified as *P. stirlingii* var. indet.

Variety	Subspecies	Collector	Locality	Voucher
<i>laxus</i>	<i>australis</i>	J. Bowen 15	Coomalbidgup via Esperance, Lort River	PERTH 00842680
<i>laxus</i>	<i>australis</i>	K.R. Newbey 1608	Culham Inlet	PERTH 00226874
<i>minutus</i> *	<i>australis</i>	R. Davis 10956	6.3 km N along track from Melaleuca Rd, c. 43 km NNW at Munglinup	PERTH 07256361
<i>minutus</i>	<i>australis</i>	N.N. Donner 3052	Location 1110, c. 30 km NNE of Young River Crossing on Ravenshorpe–Esperance road	PERTH 00226386
<i>minutus</i>	<i>australis</i>	Hj. Eichler 20277	S portion of Location 1117, c. 45 km N of Stokes Inlet (Stokes Inlet is c. 75 km W of Esperance)	PERTH 00335665
<i>minutus</i>	<i>australis</i>	P.G. Wilson 8042	Block 1156, Oldfield location, 13 km W of Young River	PERTH 230502, CANB
<i>pumilus</i>	<i>stirlingii</i>	R.J. Cranfield 2557	36.89 km W from Denham turnoff, Tamala Station	PERTH 220248
<i>pumilus</i>	<i>stirlingii</i>	B.H. Smith 1026	Avon Loc. 18304, 2 miles SW of Mannamanning	PERTH 02664208
<i>stirlingii</i>	<i>stirlingii</i>	C. Andrews 1: 715	Blackwall Reach	PERTH 00226815
<i>stirlingii</i>	<i>stirlingii</i>	D.R. Bellairs 1093	10 km E of Kalbarri	PERTH 00232033
<i>stirlingii</i>	<i>stirlingii</i>	G. Bent 71 & K.F. Kenneally 7530	Yanchep National Park, behind the emu enclosure	PERTH 00225916
<i>stirlingii</i>	<i>stirlingii</i>	E.M. Bennett 182	Yanchep, 33 miles N of Perth	PERTH 00226300
<i>stirlingii</i>	<i>stirlingii</i>	A. Bowden 11	3 km S of Seabird	PERTH 04594819
<i>stirlingii</i>	<i>stirlingii</i>	N.T. Burbidge 8043	Moore River Road, N of Yanchep National Park	PERTH 00226394
<i>stirlingii</i>	<i>stirlingii</i>	A.C. Burns 111	East Yuna, NE of Geraldton	PERTH 00226351, MEL
<i>stirlingii</i>	<i>stirlingii</i>	A.C. Burns 139	Between Walkaway and Burma Rd, SE of Geraldton	PERTH 00222747, CANB
<i>stirlingii</i>	<i>stirlingii</i>	Y. Chadwick 1783	172.5 miles [276 km] from Mount Magnet, Geraldton road	PERTH 00231525
<i>stirlingii</i> ^	<i>stirlingii</i>	R. Davis 417	10 km SW of Regans Ford	PERTH 04590856
<i>stirlingii</i>	<i>stirlingii</i>	Dr Diels & Pritzel 567	Swan district	PERTH 00226785
<i>stirlingii</i> ^	<i>stirlingii</i>	J. Docherty 101	Railway Track, 1.4 km E of Peter Rd	PERTH 06058825
<i>stirlingii</i> ^	<i>stirlingii</i>	J. Docherty 198	Railway reserve 3.4 km E of Peter Rd on Mullewa/Geraldton Rd	PERTH 06877729
<i>stirlingii</i>	<i>stirlingii</i>	J. Firth 17	Waggrakine	PERTH 05396468
<i>stirlingii</i>	<i>stirlingii</i>	C.A. Gardner 662	Mogumber	PERTH 00231967
<i>stirlingii</i>	<i>stirlingii</i>	C.A. Gardner 1162	Mogumber	PERTH 00231975

<i>stirlingii</i>	<i>stirlingii</i>	<i>A.S. George</i> 9753	Near Warradong Spring, SW of Mingenew	PERTH 231959
<i>stirlingii</i>	<i>stirlingii</i>	<i>E.A. Griffin</i> 2516	Hill S of Cockleshell Gully, NE of Jurien	PERTH 231932
<i>stirlingii</i>	<i>stirlingii</i>	<i>E.A. Griffin</i> 6651	Near coast, Wanagaren Nature Reserve (# 31675), E of Wedge Is.	PERTH 3155412
<i>stirlingii</i>	<i>stirlingii</i>	<i>J. Havel</i> 207	Caraban Rd, NW of Yanchep	PERTH 00226769
<i>stirlingii</i>	<i>stirlingii</i>	<i>R. Helms s.n.</i>	North Fremantle	PERTH 00226807
<i>stirlingii</i>	<i>stirlingii</i>	<i>R. Hnatiuk</i> 761377	26 km SE of Coomallo Ck on Brand Hwy	PERTH 232424
<i>stirlingii</i>	<i>stirlingii</i>	<i>A.M. James</i> 163	Yanchep National Park: E side of main road, 2 miles N of park entrance turnoff	PERTH 00226831
<i>stirlingii</i> <sup>^</sup>	<i>stirlingii</i>	<i>G.J. Keighery &amp; N. Gibson</i> 6032	200 m N of Burma Rd, Burma Road Nature Reserve, c. 45 km NW Mingenew	PERTH 06680267
<i>stirlingii</i>	<i>stirlingii</i>	<i>K.F. Kenneally</i> 2421	Proposed flora reserve, 11 km E York, then 5 km along Tammin Rd	PERTH 231924
<i>stirlingii</i>	<i>stirlingii</i>	<i>K.J. Knight</i> 364	Wongan Hills Experimental Farm, Reserve 18672, Craig Rd, c. 6.5 km by road N of Wongan Hills	PERTH 823503
<i>stirlingii</i>	<i>stirlingii</i>	<i>F. Lullfuz</i> L 1922	Badgingarra West	PERTH 00226378
<i>stirlingii</i>	<i>stirlingii</i>	<i>K. Macey</i> 796	Poison Paddock; New Norcia	PERTH 07192959
<i>stirlingii</i>	<i>stirlingii</i>	<i>A. Morrison s.n.</i>	Watheroo	PERTH 00231940
<i>stirlingii</i>	<i>stirlingii</i>	<i>A.E. Orchard</i> 4200	Just outside E boundary of Kalbarri National Park, on road to Ajana	PERTH 231541
<i>stirlingii</i> <sup>^</sup>	<i>stirlingii</i>	<i>M. Puckridge</i> 23	Behind the CWC Senior Citizens Centre, Bashford St., Jurien Bay	PERTH 05455677
<i>stirlingii</i> <sup>*</sup>	<i>stirlingii</i>	<i>W. Rogerson</i> 347	Yuna, NE of Geraldton	PERTH 00239585
<i>stirlingii</i>	<i>stirlingii</i>	<i>R.D. Royce</i> 1121	E of Geraldton	PERTH 00305502
<i>stirlingii</i>	<i>stirlingii</i>	<i>R.D. Royce</i> 8015	Eradu, 0.5 mile from Greenough River	PERTH 00226823, CANB
<i>stirlingii</i>	<i>stirlingii</i>	<i>B.H. Smith</i> 315	Railway near Manmanning (south) at No. 3301 telephone pole	PERTH 232416, AD, BRI, CBG, HO, NSW
<i>stirlingii</i>	<i>stirlingii</i>	<i>A. Strid</i> 21687	Hill River	PERTH 232009
<i>stirlingii</i>	<i>stirlingii</i>	<i>A. Strid</i> 21721	By the small town of Piawaning, NE of New Norcia	PERTH 232408
<i>stirlingii</i>	<i>stirlingii</i>	<i>V. Westcott</i> L.D. 58 A	Beekeepers Nature Reserve (NR 24496), 17.1 km W of Brand Hwy along Eneabba–Coolimba road	PERTH 08146713
<i>stirlingii</i>	<i>stirlingii</i>	<i>D.J.E. Whibley</i> 4948	15 km W of Coomberdale, near border of Avon District and South Irwin	PERTH 226297
<i>stirlingii</i>	<i>stirlingii</i>	<i>R.T. Wills</i> RTW 1	Site 94, Beekeepers Reserve	PERTH 06384005
<i>stirlingii</i>	<i>stirlingii</i>	<i>R.T. Wills s.n.</i>	Site 50, Beekeepers Reserve Collection	PERTH 06400752
<i>stirlingii</i> <sup>^</sup>	<i>stirlingii</i>	<i>D. Woodman</i> GW OP 13	Vacant Crown Land N of State Forest 65 North	PERTH 06129889





**Figure 1.** UPGMA dendrogram and (inset) 2-dimensional NMDS ordination of the four varieties of *Ptilotus stirringii* based on 50 specimens by 10 characters, using the Gower metric. The direction of contribution of each character to the ordination, calculated by the Spearman rank correlation coefficient, is illustrated in the circular inset. Samples labelled by their PERTH sheet numbers. Character codes as for Table 1.

Three specimens of var. *stirlingii* (PERTH 231959, PERTH 00239585, PERTH 05455677) are peripheral to the remaining samples in both the cluster analysis and NMDS (Figure 1). Of these, PERTH 00239585 had previously been identified as *P. aff. stirlingii* and is notable for having small leaves and flowers, while PERTH 05455677 had not been identified to variety originally and is notable for having small flowers. The third specimen, PERTH 231959, differs from the remaining var. *stirlingii* specimens in having longer and broader leaves.

**Table 3.** Spearman rank correlation coefficients between the characters used to create the NMDS ordination and the ordination axes. Character codes as for Table 1.

	BL	BrL	TL	SL	LL	LW	LL/LW	DW/LL	IND	HAB
MDS 1	-0.4596	-0.5856	-0.3078	0.1061	-0.4351	-0.7598	0.4296	-0.5815	0.3105	0.5582
MDS 2	-0.0617	0.0751	-0.1698	-0.4614	-0.5968	-0.5606	0.0682	-0.0761	-0.8165	-0.2315

Discussion

The morphometric analysis suggests that only two subspecific taxa should be recognised in *Ptilotus stirlingii*, rather than the four varieties recognised by Benl (1959, 1967). Of the characters used by Benl to differentiate between the pairs of varieties, tepal length (for vars *pumilus* cf. *stirlingii*) and leaf shape (for vars *laxus* cf. *minutus*) intergrade, have low Spearman Rank coefficients on MDS2 (Table 3) and do not clearly separate their respective taxa. Indumentum is more highly correlated with the ordination ( $R = -0.8165$  on MDS2); however, some specimens of var. *stirlingii* are as woolly as specimens of var. *pumilus*, and there is a complete intergrade of indumentum density from nearly glabrous to densely woolly among the northern specimens.

Accordingly, we recognise here two taxa, a northern taxon combining var. *stirlingii* and var. *pumilus*, and a southern taxon, combining var. *minutus* and var. *laxus*, based on the two clear groups recovered by the classification and ordination. These two taxa are best recognised as subspecies of a broadly circumscribed *P. stirlingii*. They are widely allopatric and differ most obviously in habit, with the southern plants being prostrate while the northern ones are arching to sprawling, and bract and bracteole length, with the northern taxon having bracts 1.8–4.5 mm long and bracteoles 3–5 mm long and the southern taxon having bracts 5.3–7.5 mm long and bracteoles 5.4–6.3 mm long. Leaf shape is a useful supplementary character, with the southern taxon having oblanceolate to obovate leaves, in addition to elliptical leaves, while the northern taxon has elliptical leaves. For clarity, the new name *Ptilotus stirlingii* subsp. *australis* R.W.Davis & R.Butcher *subsp. nov.* is erected here for the southern taxon, in preference to retaining either of Benl’s varietal names. The northern taxon retains the autonym at subspecific rank.

Taxonomy

***Ptilotus stirlingii*** (Lindl.) F.Muell., *Syst. Census Austral. Pl.* 1:28 (1882). *Trichinium stirlingii* Lindl., *Edwards’s Bot. Reg.* 25: 28 (1839). *Type:* Swan River Colony, [Western Australia], *J. Stirling s.n.* (*holo:* CGE *n.v.*).

*Trichinium carneum* Moq. in A.P. de Candolle, *Prodr.* 13(2): 291 (1849). *Type:* Lower Swan R., [Western Australia], *C. Fraser* 158 (*holo:* P? *n.v.*; *iso:* K image!).

Arching, decumbent, sprawling or prostrate *perennial herb* to 30 cm high. *Stems* terete, ribbed, sparsely hairy to woolly, sometimes glabrescent. *Cauline leaves* alternate, petiolate, narrowly elliptical or oblanceolate to obovate, 5–50 mm long, 1–8 mm wide, glabrous or sparsely hairy to woolly, margins undulate. *Inflorescences* solitary, terminal, pink to pale pink, spherical or ovoid to shortly cylindrical, 10–37 mm long, 15–28 mm wide; *bracts* translucent, tinged pink towards centre, narrowly ovate to ovate, 1.8–7.5 mm long, sparsely hairy with verticillate to nodose hairs, becoming glabrous towards the margins; *bracteoles* translucent, tinged pink along midrib, ovate to broadly ovate or obovate to broadly obovate, 3–6.3 mm long, glabrous or sometimes with sparse, verticillate hairs along midrib. *Flowers* pedicellate; *outer tepals* pink to pale pink, tinged white, narrowly oblanceolate, concave, (7.2–)8–14 mm long, hairy except at apex, with verticillate hairs, apex rounded to truncate, sometimes retuse or apiculate, serrated; *inner tepals* (6.8–)7.5–13.5 mm long, with a basal tuft of hairs on inner face; *staminal cup* 1.7–3 mm long, glabrous; *stamens* 2; *staminodes* 3; *style* slightly curved, subcentrally fixed to ovary, 2.9–5.1 mm long; *ovary* glabrous. *Seed* slightly glossy to glossy, brown, to 1.8 mm long.

*Notes.* *Ptilotus stirlingii* is often misidentified as *P. sericostachyus* and is relatively close morphologically. The following key can be used to separate *P. sericostachyus* and the infraspecific taxa of *P. stirlingii*.

#### Key to taxa

1. Staminal cup hairy, style markedly falcate..... ***P. sericostachyus***
1. Staminal cup glabrous, style slightly curved..... ***P. stirlingii***
  2. Plants arching or sprawling, bracts 1.8–4.5 mm long, bracteoles 3–5 mm long..... ***P. stirlingii* subsp. *stirlingii***
  2. Plants prostrate, bracts 5.3–7.5 mm long, bracteoles 5.4–6.3 mm long..... ***P. stirlingii* subsp. *australis***

#### *Ptilotus stirlingii* subsp. *stirlingii*

*Ptilotus stirlingii* (Lindl.) F.Muell. var. *pumilus* Benl, *Muelleria* 1: 108 (1959). *Type*: Shark Bay, Western Australia, October 1877, *F. Mueller s.n. (holo: MEL!)*.

Arching, decumbent or sprawling *perennial herb* to 30 cm high. *Stems* terete, ribbed, sparsely hairy to woolly. *Cauline leaves* narrowly elliptical to oblanceolate, 5–50 mm long, 1–8 mm wide, sparsely hairy to woolly. *Inflorescences* spherical to ovoid, 10–35 mm long, 15–27 mm wide; *bracts* narrowly ovate to ovate, 1.8–4.5 mm long; *bracteoles* ovate to broadly obovate, 3–5 mm long. *Outer tepals* (7.2–)8–12 mm long; *inner tepals* (6.8–)7.5–11.5 mm long; *staminal cup* 1.7–2.5 mm long; *style* 2.9–5 mm long; *ovary* glabrous. *Seed* glossy, brown, to 1.7 mm long.

*Distribution and habitat.* Distributed from Shark Bay southward to Perth, in the Swan Coastal Plain and Geraldton Sandplains IBRA regions, and eastward into the west and north-western edges of the Avon Wheatbelt IBRA region. Found in a wide range of habitats. Common on sandy, coastal heaths through to kwongan sandplains and woodlands.

*Phenology.* Flowering from late October through to January.



*Notes.* The Priority One conservation listing for *Ptilotus stirlingii* var. *pumilus* (Smith 2010) is no longer necessary as this variety has been subsumed within subsp. *stirlingii*, which is not considered to be under threat.

***Ptilotus stirlingii* subsp. *australis*** R.W.Davis & R.Butcher, *subsp. nov.*

*Typus:* 6.3 km north along track from Melaleuca Road, c. 43 km north-north-west of Munglinup, Western Australia, 33° 20' 55.3" S, 120° 39' 10.3" E, 12 December 2005, R. Davis 10956 (*holo:* PERTH 07256361; *iso:* CANB, K).

*Ptilotus stirlingii* (Lindl.) F.Muell. var. *minutus* Benl, *Mitt. Bot. Staatssamml. München* 6: 503 (1967). *Type:* Grass Patch, Western Australia, October 1931, W.E. Blackall 1028 (*holo:* PERTH!; *iso:* PERTH!).

*Ptilotus stirlingii* (Lindl.) F.Muell. var. *laxus* (Benth.) Benl, *Mitt. Bot. Staatssamml. München* 6: 500 (1967). *Trichinium laxum* Benth., *Fl. Austral.* 5: 232 (1870); *Ptilotus laxus* (Benth.) F.Muell., *Syst. Census Austral. Pl.* 1: 28 (1882). *Type:* between Cape Le Grand and Cape Pasley, [Western Australia], G. Maxwell s.n. (*holo:* MEL n.v.; *iso:* BM n.v., K (image!); MEL n.v.).

Prostrate perennial herb to 8 cm high. *Stems* terete, ribbed, sparsely hairy. *Cauline leaves* narrowly elliptical or oblanceolate to obovate, 5–30 mm long, 2–7 mm wide, glabrous to sparsely hairy. *Inflorescences* ovoid to shortly cylindrical, 20–37 mm long, 22–28 mm wide; *bracts* narrowly ovate, 5.3–7.5 mm long; *bracteoles* broadly ovate to obovate, 5.4–6.3 mm long. *Outer tepals* 10–14 mm long; *inner tepals* 10.5–13.5 mm long; *staminal cup* 2.5–3 mm long; *style* 3.5–5.1 mm long; *ovary* glabrous. *Seed* slightly glossy, brown, to 1.8 mm long.

*Distribution and habitat.* Distributed through a large part of the Esperance Plains IBRA region, where it is mostly found in coastal areas, although extends as far inland as the Stirling Range and Grasspatch. Occurs in heathlands and mallee woodlands on deep sands to gravelly loams.

*Phenology.* Flowering from late October though to January.

*Notes.* *Ptilotus stirlingii* subsp. *australis* is poorly collected but from the material available it appears to be reasonably consistent morphologically. Field observations suggest that it may only be abundant after fire, perhaps accounting for the relatively few collections.

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## *Logania sylvicola* (Loganiaceae), a new species from south-west Western Australia

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### Abstract

Cranfield, R.J., Hislop, M. & Macfarlane, T.D. *Logania sylvicola* (Loganiaceae), a new species from south-west Western Australia. *Nuytsia* 20: 271–275 (2010). *Logania sylvicola* Cranfield, Hislop & T. Macfarlane, a new species endemic to the Jarrah Forest Bioregion of south-west Western Australia, is described, illustrated and mapped.

### Introduction

*Logania* R.Br. (Loganiaceae) is a genus of c. 36 species, with one endemic species in New Caledonia, one endemic to New Zealand and the rest in Australia (Conn & Brown 1996). Currently, 22 species are recognised in Western Australia, of which 17 are endemic (Western Australian Herbarium 1998–). The genus is divided into two sections, sect. *Logania* A.DC. which is characterised, among other features, by dioecy and is well represented in both eastern and western Australia, and sect. *Stomandra* (R.Br.) DC. with bisexual flowers and with all species in south-western Australia except one in eastern Australia (Conn & Brown 1996). The genus has been revised by Conn (1994, 1995b) and treated in *Flora of Australia* (Conn & Brown 1996). Subsequently, Cranfield contributed to the description of the new species *L. wendyae* Cranfield & Keighery (2006) from south-western Australia. Recently, specimens from the Collier–Darkan area that failed to key adequately were noticed by Hislop. Investigation showed that although these specimens are similar to *L. nanophylla* Conn (1995b) from the Coolgardie Bioregion, morphological differences, combined with the geographic clustering of the anomalous specimens and the wide geographic and climatic separation from *L. nanophylla*, support the recognition of a new species. Accordingly, *L. sylvicola* Cranfield, Hislop & T. Macfarlane is described here. This species is known from five specimens from the Jarrah Forest Bioregion, collected in open forest or woodland areas on the western edge of the southern wheatbelt of Western Australia (Figure 1).

### Methods

This paper follows the terminology adopted by Conn (1995a) to describe the inflorescence structure characteristic of the genus *Logania*. The term *propodium* refers to the penultimate internode of the axis terminated by a pair of bracts (prophylls) followed by the ultimate internode, the *anthopodium* (if



present) and the flower. The *hypopodium*, the lower portion of the flower stalk that forms in the axis of the branchlet and leaf, and the upper-most part of the stalk (the *anthopodium*) are absent or too small to measure in the new species.

### Taxonomy

***Logania sylvicola*** Cranfield, Hislop & T. Macfarlane, *sp. nov.*

*Loganiae nanophyllae* affinis sed foliis oppositis (non fasciculatis), linearibus 3–5 mm longis, lobis corollae 1–1.5 mm longis, habitu fruticoso ad 50 cm altitudinem differt.

*Typus*: Bennelaking Conservation Park, south-west of Darkan, Western Australia [precise locality withheld for conservation reasons], 30 August 2009, *M. Hislop* 3916 (*holo*: PERTH 08038880; *iso*: CANB, MEL).

Erect to spreading compact multi-branched *shrub* 50 cm high, up to 50 cm wide, dioecious. *Branches* erect, moderately to sparsely hairy; hairs coarse, antrorse to slightly curved, white, *c.* 0.1–0.2 mm long. *Leaves* opposite, subsessile; petiole 0.2–0.3 mm long, glabrous; stipules reduced to a stipular line with occasional short hair tufts; lamina slightly recurved, linear, 3–5 mm long, 0.5–0.6 mm wide; abaxial surface minutely hairy, obscured by the revolute margins, midrib exposed and glabrous; adaxial surface shiny, glabrous; base cuneate; margin strongly revolute; apex acute and slightly recurved. *Inflorescence* terminal or in leaf axils, erect or slightly pendulous, triadic to botryose, 3–5 (7-) flowered; hypopodium 1–2 mm long; lower prophylls 2, opposite, 1–1.5 mm long; propodium 1–1.5 mm long; flowers unisexual, highly aromatic, sessile to subsessile in upper 2 prophylls, prophylls opposite, 0.5–1.0 mm long. *Male flowers* 1.5–2 mm long; *calyx* 1.0–2.0 mm long, dark brown to black, glabrous except for short white hairs on margins of lobes, lobes ovate, 1 mm long, 1 mm wide; apex obtuse; *corolla* white to cream, 1.5–2.0 mm long, tube about as long as lobes, orifice with a low rim of papillae, lobes spreading, ovate, 1.0–1.5 mm long, 1–1.5 mm wide, papillose on surface and margin, apex rounded; *stamens* 5, inserted at middle of tube, filament *c.* 0.3–0.5 mm long, anthers *c.* 0.5 mm long; *pistillode* with ovary virtually absent, the disk broad and flat, style well-developed, *c.* 0.5–0.75 mm long, stigma capitate to slightly bilobed. *Female flowers* similar but smaller, 1.0–1.5 mm long; *calyx* 0.5–1.0 mm long, lobes 0.5–0.75 mm long, 0.5 mm wide; *corolla* white to cream, 1–1.5 mm long, tube 0.5–0.75 mm long, lobes 0.5–1 mm long, 0.5–1 mm wide; *staminodes* absent or present, *c.* 0.3–0.5 mm long; ovary ovoid or nearly so, 0.5 mm long, style *c.* 0.5 mm long, stigma capitate to bilobed; locules 2, ovules 1 per locule, ellipsoid, *c.* 0.25 mm long. *Capsule* ellipsoid with two carpels, each carpel separated almost to the base, apex apiculate; dehiscing 3/4 of the length; carpel 5.0–5.5 mm long, 3.0–3.5 mm wide. Seed brown, ellipsoid, slightly compressed, 4.0–4.5 mm long, 2.5 mm wide; surface reticulate. (Figures 2, 3)

*Other specimens examined*. WESTERN AUSTRALIA: [localities withheld for conservation reasons] Sep. 2005, *E.M. Bennett* BVC073-5 (PERTH 07331673); 15 Aug. 1994, *V. Crowley* DKN691 (PERTH 05322480); 10 Dec. 1997, *R. Davis* 4687 (PERTH 04926544); 9 Sep. 1994, *C.M. Lewis* 9 (PERTH 04921194).

*Distribution and habitat*. All five collections were made from the Jarrah Forest Bioregion of south-western Western Australia, occurring in woodland to open forest vegetation on the mid-slope of laterite rises associated with brown clay to clayey sand (Figure 1).

*Phenology.* Flowering in August–September and fruiting in October.

*Conservation status.* Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora: recently listed as Priority Two. This species is known from only five locations, one of which is in a Conservation Park. Additional surveys are required to determine the true status of this species.

*Etymology.* The specific epithet is derived from *sylva*, Latin for woodland or forest, and *-cola*, inhabiting, in reference to the habitat of the species.

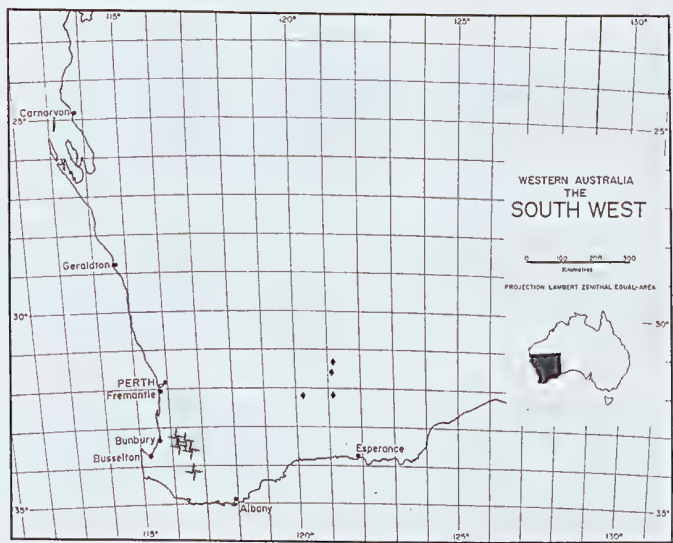


Figure 1. Distribution of *Logania sylvicola* (+) and *Logania nanophylla* (◆) in south-west Western Australia..



Figure 2. *Logania sylvicola*. A – male flower from above showing throat rim; B – dehiscent capsule; C – seed. Photographs by R.J. Cranfield from M. Hislop 3916 (A) and R. Davis 4687 (B & C). Scale bars =1mm.

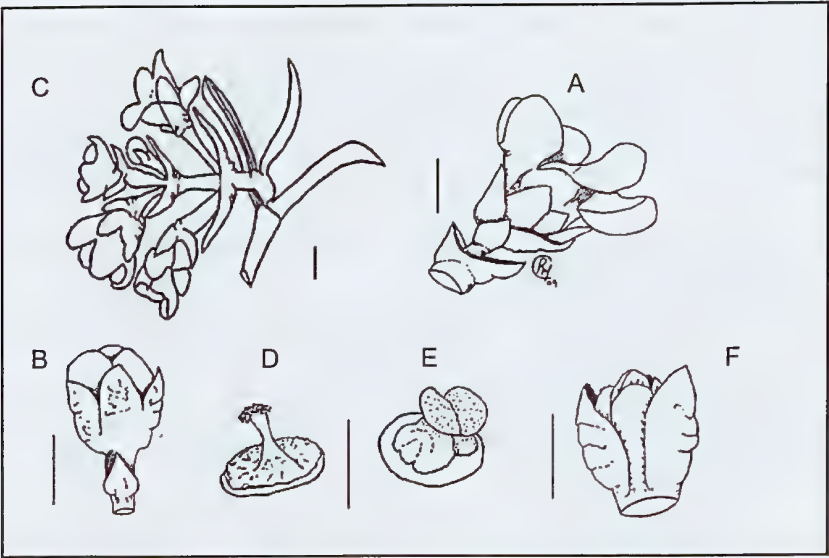


Figure 3. *Logania sylvicola*. A—flower; B—mature bud; C—inflorescence; D—male flower pistillode and disk; E—female flower gynoeceum and disk; F—immature bud. Drawings by R.J. Cranfield from M. Hislop 3916. Scale bar = 1 mm.

*Affinities.* *Logania sylvicola* is morphologically most similar to *L. nanophylla*, the differences between these two species being shown in Table 1. Like *Logania nanophylla* (Conn & Brown 1996), *L. sylvicola* has features which place it in *Logania* sect. *Logania*, viz. dioecy, woody branch bases, obtuse calyx lobes, stamens inserted in the middle of the corolla tube, and glabrous filaments.

**Table 1.** Comparison of selected characters between *Logania nanophylla* and *L. sylvicola* including features of male and female plants.

Characters	<i>Logania nanophylla</i>		<i>Logania sylvicola</i>	
	male	female	male	female
<b>Leaf</b>				
shape	elliptic		linear	
arrangement	clustered		opposite	
length (mm)	1.2–2.1	2.0–2.5	3.0–5.0	3–4
<b>Propodium</b>				
length (mm)	0.5–1.0		1.0–1.5	
<b>Calyx</b>				
length (mm)	0.7–1.0	0.5	1.0–2.0	0.5–1.0
<b>Corolla</b>				
total length (mm)	1.5–2.0	1	1.5–2.0	1.0–1.5
lobe length (mm)	0.9–1.1	0.5–1	1.0–1.5	1
<b>Style</b>				
length (mm)	c. 0.1–0.5	0.25–0.5	c. 0.5–0.75	c. 0.5
<b>Filament</b>				
length (mm)	c. 0.3		c. 0.3–0.5	



*Notes.* Female plants of both species are poorly collected and further collections are required. In the PERTH collection there is only one female specimen of each taxon. The females have less conspicuous flowers and may be generally overlooked by collectors thinking they are not fully in flower.

### Acknowledgements

We wish to thank Paul Wilson for translating the diagnosis into Latin.

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## ***Darwinia hortiorum* (Myrtaceae: Chamelaucieae), a new species from the Darling Range, Western Australia**

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### **Abstract**

Thiele, K.R. *Darwinia hortiorum* (Myrtaceae: Chamelaucieae), a new species from the Darling Range, Western Australia. *Nuytsia* 20: 277–281 (2010). The distinctive, new, rare species *Darwinia hortiorum* is described, illustrated and discussed. Uniquely in the genus it has strongly curved-zygomorphic flowers with the sigmoid styles arranged so that they group towards the centre of the head-like inflorescences.

### **Introduction**

*Darwinia* Rudge comprises *c.* 90 species, mostly from the south-west of Western Australia with *c.* 15 species in New South Wales, Victoria and South Australia. Phylogenetic analyses (M. Barrett, unpublished) have shown that the genus is polyphyletic, with distinct eastern and western Australian clades. Along with the related genera *Actinodium* Schauer, *Chamelaucium* Desf., *Homoranthus* A.Cunn. ex Schauer and *Pileanthus* Labill., the *Darwinia* clades are nested in a paraphyletic *Verticordia* DC.

Many undescribed species of *Darwinia* are known in Western Australia, and these are being progressively described (Rye 1983; Marchant & Keighery 1980; Marchant 1984; Keighery & Marchant 2002; Keighery 2009). A significant number of taxa in the genus are narrowly endemic or rare and are of high conservation significance. Although taxonomic reassignment of the Western Australian species of *Darwinia* may be required in the future, resolving the status of these undescribed species and describing them under their current genus helps provide information for conservation assessments and survey.

*Darwinia hortiorum* K.R.Thiele was first collected by Fred and Jean Hort in 2008 from granite outcrops in the Monadnocks Conservation Park and adjacent Boonering State Forest. It is clearly distinct from any known taxon, and is described here as new.



## Taxonomy

### ***Darwinia hortiorum* K.R.Thiele, *sp. nov.***

Species floribus valde curvatis zygomorphicis, stylis sigmoideis a congeneribus diversa.

*Typus*: Monadnocks Conservation Park [precise locality withheld for conservation reasons], Western Australia, 15 November 2009, *F. Hort* 3525 & *K. Thiele* (*holo*: PERTH08243832; *iso*: CANB, MEL, NSW, K).

*Darwinia* sp. Wandering (F. Hort 3273), Western Australian Herbarium, in *FloraBase*, <http://florabase.calm.wa.gov.au> [accessed 20 July 2010]

Erect to spreading, densely branched, rather compact, glabrous *shrubs* to 70 cm tall and to 80 cm wide, single-stemmed at the base with spreading main branches bearing numerous, ascending, leafy branchlets; young stems pale, with corrugate-corky, decurrent ridges extending for several nodes below each leaf insertion; bark on older stems reddish-brown, papery, decorticating in flakes. *Leaves* alternate, widely spreading,  $\pm$  triquetrous, narrowly ovate to almost linear, 3–6 mm long, *c.* 1 mm wide, with a petiole *c.* 0.3 mm long; adaxial surface dark green, flat, nerveless, with obscure, sunken, pale oil glands tending to form a row each side of the midline; abaxial surface paler, keeled by a prominent, thickened midrib, with obscure, sunken, pale, scattered oil glands; margins entire or minutely, irregularly denticulate, with a very narrow, hyaline border; apex hyaline-acuminate but not pungent. *Inflorescences* erect, terminal to seasonal growth units (which continue to grow shortly after flowering), comprising 14–18(–22) pedunculate, 2-bracteolate flowers each in the axil of a bract, the apex vegetative and growing on shortly after flowering; inflorescence bracts slightly longer and wider than the leaves but otherwise similar; peduncles of the lowermost flowers 1.5–3.5 mm long, upper ones successively shorter; bracteoles broadly ovate, obtuse, with or without a soft, terminal apiculum, connate for the lowermost 1/4–1/3, closely enveloping the base of the hypanthium, *c.* 4 mm long (extending to the base of the sepals), scarious, pale brown with a darker, keeled midrib, with scattered translucent oil glands towards the apex. *Hypanthium* deeply 5-grooved, curved, 3.5–4 mm long, smooth, glossy reddish-brown paler at the base; *sepals* *c.* 3 mm long, erect (closely appressed to the petals), obtuse, thick, fleshy, dark green with pale, scarious margins, warty with scattered, prominent, pale oil glands; *petals* 2–3 mm long, those facing the centre of the inflorescence shorter than those opposite so that the corolla is curved-zygomorphic, incurved-erect, obtuse, thick, fleshy (similar in texture to the sepals), pale yellowish or suffused with crimson, smooth, glossy, with few, embedded oil glands. *Stamens* 10; anthers globose, *c.* 0.3 mm long, on filaments 0.8–1.5 mm long, protruding between the petals after anthesis; staminodes ovate, obtuse, *c.* 0.6 mm long, largely free from the stamens. *Style* distinctly sigmoid, the free portion curved so that the styles group towards the centre of the inflorescence, pale greenish to pale pink; substigmatic hairs *c.* 0.25 mm long, in a band *c.* 0.5 mm long immediately below the minute stigma, covered in oil and pollen at anthesis. *Mature fruits* not seen. (Figure 1)

*Other specimens examined*. WESTERN AUSTRALIA (all PERTH): [precise localities withheld for conservation reasons] Boonering State Forest, 23 Aug. 2008, *F. Hort* 3212 & *J. Hort*; Boonering State Forest, 23 Sep. 2008, *F. Hort* 3273; Boonering State Forest, 2 Nov. 2009, *F. Hort* 3514; Monadnocks Conservation Park, 15 Nov. 2009, *F. Hort* 3526 & *J. Hort*.

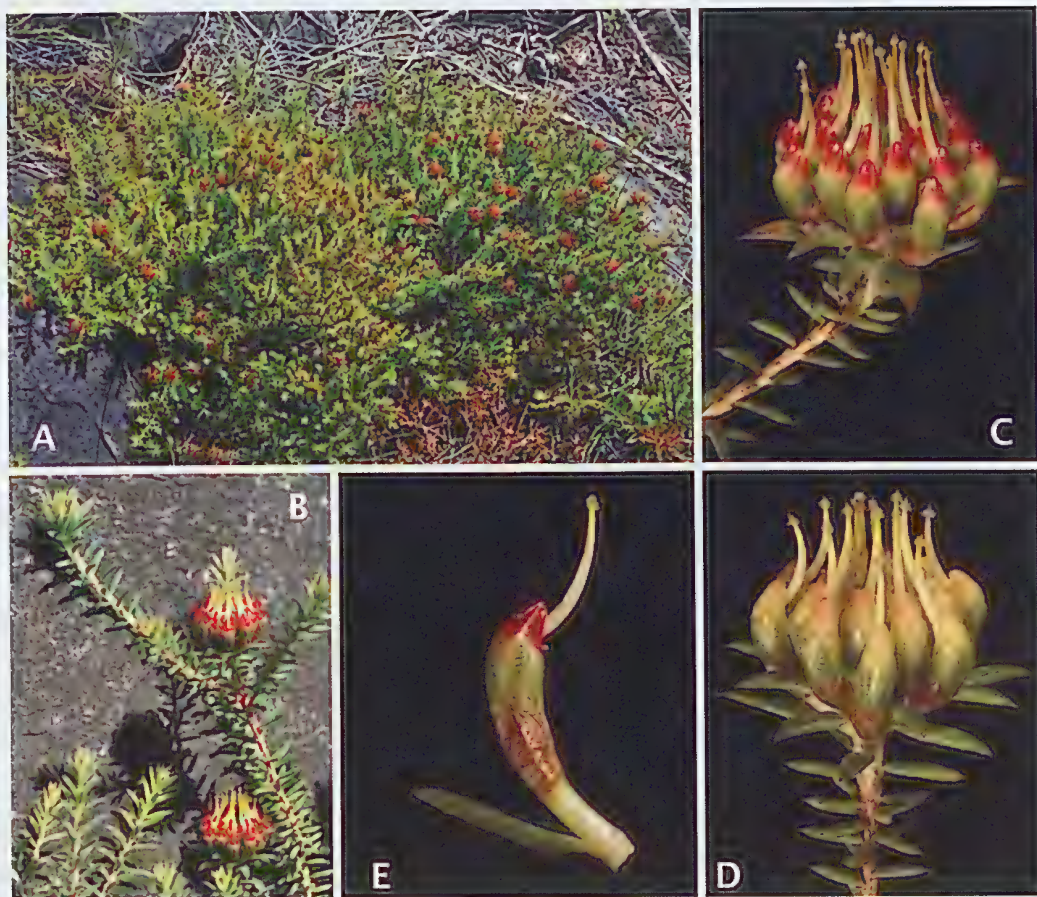


Figure 1. *Darwinia hortiorum*. A – individual shrub; B – flowering branchlets; C, D – inflorescences (C – red-flowered variant; D – yellow-flowered variant); E – individual flower of the red-flowered variant. Photographers: A, B – J. Hort; C, D, E – K. Thiele.

**Distribution.** Currently known from five localities in the Jarrah Forest IBRA Bioregion (Department of the Environment, Water, Heritage and the Arts 2008), in an area  $c. 3 \times 3$  km in the Monadnocks Conservation Park and adjacent Boonering State Forest (Figure 2). 4

**Habitat.** All known populations are found in jarrah forest growing in association with large granite outcrops and their drainage lines. Close to the outcrops the plants are usually found growing in shallow granitic soil with broken stone fringing the main outcrops. On drainage lines more distant from outcrops the plants are found growing in loam or loam/clay soil associated with laterite. Characteristic associated species include *Allocasuarina humilis*, *Andersonia* spp., *Grevillea bipinnatifida*, *G. manglesii*, *Banksia recurvistylis*, *Hakea undulata*, *H. trifurcata*, *Verticordia insignis*, *Calytrix depressa*, *Xanthorrhoea preissii* and *Hibbertia hypericoides*.

**Phenology.** Flowers from late September to early December.

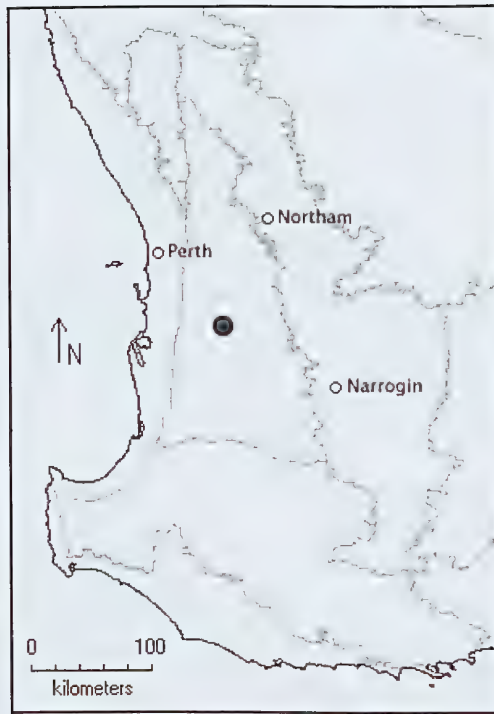


Figure 2. Distribution of *Darwinia hortiorum* (●) in south-west Western Australia. IBRA Bioregion boundaries (Department of the Environment, Water, Heritage and the Arts 2008) are shown in grey

**Conservation status.** *Darwinia hortiorum* was listed as Priority One under the informal phrase name *Darwinia* sp. Wandering (F. Hort 3273) by Smith (2010); this remains appropriate given its very localized distribution. It is locally common where it occurs, with population estimates to >500 plants. Some populations are in a gazetted Conservation Park; however, the area in which it occurs is threatened by *Phytophthora cinnamomi* dieback. Plants are killed by fire; many non-flowering juvenile plants have been observed in an area burnt 3–4 years previously (F. Hort, pers. comm.), suggesting that frequent fires may be deleterious for the species.

**Etymology.** Named in honour of Fred and Jean Hort, enthusiastic field botanists, expert plant-hunters and national treasures.

**Affinities and notes.** *Darwinia hortiorum* is distinctive with no obvious close relatives. It is superficially similar to *D. thymoides*, which occurs with it at some sites. Both species are small shrubs with small, ± erect inflorescences lacking distinctly differentiated inflorescence bracts. However, *D. thymoides* has opposite, ± flat leaves, fewer (2–10) flowers per inflorescence, small, free bracteoles <1/4 the length of the hypanthium, styles which are incurved at the apex and distinctive, warty oil glands at the apices of the petals. Vegetatively, *D. hortiorum* is similar to *D. apiculata*, but the inflorescences in that species are subtended by differentiated, coloured bracts.



Many species of *Darwinia* have slightly curved flowers, usually with the styles uncinatate at their tips. In *D. hortiorum*, the corolla is more strongly zygomorphic than in other species, with the robust style emerging excentrically from the erect, fleshy petals and sigmoidally curved in such a way that all styles are presented in the centre of the inflorescence and are erect and not uncinatate. This morphology is not seen in any other known species. The large, connate, bracteoles also appear to be unique.

In all populations there is a mix of red-flowered (with the petals distally suffused with crimson) and yellow-flowered (with the petals not suffused and hence pale yellow) individuals. There is no apparent colour change in the flowers after anthesis. The flowers have a pollen-presentation system, with a mix of pollen grains and oil deposited on the substigmatic brush of hairs as the style elongates during anthesis.

### Acknowledgments

I would like to acknowledge Fred and Jean Hort for their diligence and expertise in surveying the flora of the Darling Range for new and noteworthy species. They brought this species to my attention, showed it to me in the field and collected excellent specimens from all known populations. Ryonen Butcher assisted during field work, Paul Wilson kindly translated the Latin diagnosis, and Mike Hislop and an anonymous reviewer provided invaluable comments on the manuscript.

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## Myxomycota census of Western Australia

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### Abstract

Knight, K.J. & Brims, M.H. Myxomycota census of Western Australia. *Nuytsia* 20: 283–307 (2010). A census of the slime mould species found in Western Australia, based on publications recording slime mould species and collections housed at the Western Australian Herbarium (PERTH), is presented. A total of 159 species in 37 genera and 12 families are recorded.

### Introduction

The phylum Myxomycota is comprised of plasmodial slime moulds which are fungi-like organisms with a two stage life cycle; the plasmodium (a slime-like single celled amoeboid stage) and sporangia (a multicellular spore producing organ required for identification) (Figure 1). This census is comprised of both classes of Myxomycota; Myxomycetes and Protosteliomycetes (Hawksworth *et al.* 1995); however all bar one record are Myxomycetes.

There have been a number of publications recording Myxomycota occurrences in Western Australia; the earliest (Cooke 1892) recorded 17 species in 12 genera and seven families. In the proceeding 90 years there appeared to be little interest in slime moulds in Western Australia, as shown by the lack of publications listing slime mould records combined with the low number of specimen records at the Western Australian Herbarium (PERTH). The earliest (and only) published listing of slime moulds was prepared by Hnatiuk (1978), who recorded just nine species in seven genera and four families, all based on field collections housed at PERTH. There has since been an increased interest in slime moulds, with a number of publications reporting records from both field collections and/or moist chamber cultures from substrate collected in Western Australia (Hnatiuk & Kenneally 1981; Ing & Spooner 1994; Mitchell 1995; McHugh *et al.* 2003; Jordan *et al.* 2006; McHugh *et al.* 2009).

In the last decade there has been an exponential increase in awareness in slime moulds in Western Australia, particularly as a result of the enthusiasm and developing identification expertise of one of us (M.B.). This has included the use of moist chamber cultures rather than relying on field collections only. The number of collections from Western Australia housed at PERTH has increased more than six fold in the past ten years, from 102 accessions in 2000 to 624 accessions in early 2010. Unsurprisingly, there has been an associated increase in the number of species recorded for the State, with 142 species from 35 genera and 12 families now represented at PERTH. Up until now, a comprehensive listing of all known species for the state has been lacking; this census reports 159 species in 37 genera and 12 families, based on both publications listing slime mould species and collections housed at PERTH (Table 1).





Figure 1. All figures are sporangia unless otherwise mentioned. A – *Ceratiomyxa fruticulosa*; B – *Badhamia foliicola*; C – *Fuligo septica*, immature; D – *Physarum viride*; E – *Lycogala epidendrum*; F – *Stemonitis smithii*; G – *Trichia persimilis*; H – Plasmodium, indeterminate; I – *Trichia decipiens*, immature. Photographs by Neale Bougher (B, I) and Peter Davison (A, C–H).

Table 1. Slime mould class, families and genera of Western Australia. The family name is systematically arranged according to Hawksworth *et al.* (1995), whilst the genera are alphabetically listed within each family.

Class	Family	Genus	No. of species
Myxomycetes	Clastodermataceae	<i>Clastoderma</i>	1
	Echinosteliaceae	<i>Echinostelium</i>	5
	Cribrariaceae	<i>Cribraria</i>	9
	Liceaceae	<i>Licea</i>	11
	Lycogalaceae	<i>Dictydiaethalium</i>	1
		<i>Lycogala</i>	2
		<i>Reticularia</i>	3
		<i>Tubifera</i>	1
	Didymiaceae	<i>Diderma</i>	7
		<i>Didymium</i>	13
	Physaraceae	<i>Badhamia</i>	6
		<i>Craterium</i>	3
		<i>Fuligo</i>	3
		<i>Leocarpus</i>	1
		<i>Physarum</i>	23
		<i>Willkommlangea</i>	1
	Stemonitidaceae	<i>Collaria</i>	1
		<i>Colloderma</i>	1
		<i>Comatricha</i>	10
		<i>Diachea</i>	2
		<i>Enerthenema</i>	1
		<i>Lamproderma</i>	2
		<i>Macbrideola</i>	4
		<i>Paradiachea</i>	1
		<i>Paradiacheopsis</i>	2
		<i>Stemonitis</i>	7
		<i>Stemonitopsis</i>	5
		<i>Symphytocarpus</i>	1
	Arcyriaceae	<i>Arcyria</i> <sup>24</sup>	12
	Dianemataceae	<i>Calomyxa</i>	1
		<i>Dianema</i>	1
	Trichiaceae	<i>Hemitrichia</i>	3
		<i>Metatrichia</i>	1
		<i>Oligonema</i>	1
		<i>Perichaena</i>	3
		<i>Trichia</i>	9
Protosteliomycetes	Ceratiomyxaceae	<i>Ceratiomyxa</i>	1

Despite these recent efforts, slime moulds remain grossly under collected. PERTH has very few records for the size of the State; with just one slime mould specimen recorded per 3920 km<sup>2</sup>. Few areas of the State have been sampled (Figure 2), with most collections from the south-west region where the climate is more conducive to opportunistic collecting (due to the ephemeral nature of slime moulds). In contrast, specimens collected in the more arid or remote regions of the state have nearly all been from moist chamber collections. The number of collections per species is also very low: 80 per cent of species are represented by less than five specimens and ten per cent of the species are based on literature records only, where specimens have not been lodged or duplicated in PERTH. In 2009, one in five specimens lodged at PERTH were new records for Western Australia. It follows that an increased collection effort in the future will inevitably lead to new records. It is of note that one sixth of the specimens lodged at PERTH are not identifiable to species level, often due to the immaturity of the collections (plasmodium only or the sporangia are immature), but also due to the lack of taxonomic expertise in Western Australia to determine if some of the specimens represent new and undescribed species.

This paper provides a census of known species occurring within Western Australia and has been prepared so that this phylum can be included on *FloraBase* (Western Australian Herbarium 1998–), providing a platform to enable attachment of additional information such as images, maps and descriptions. This census cannot be considered representative of the diversity or distribution of slime moulds in Western Australia, rather a baseline against which future improvements in our knowledge

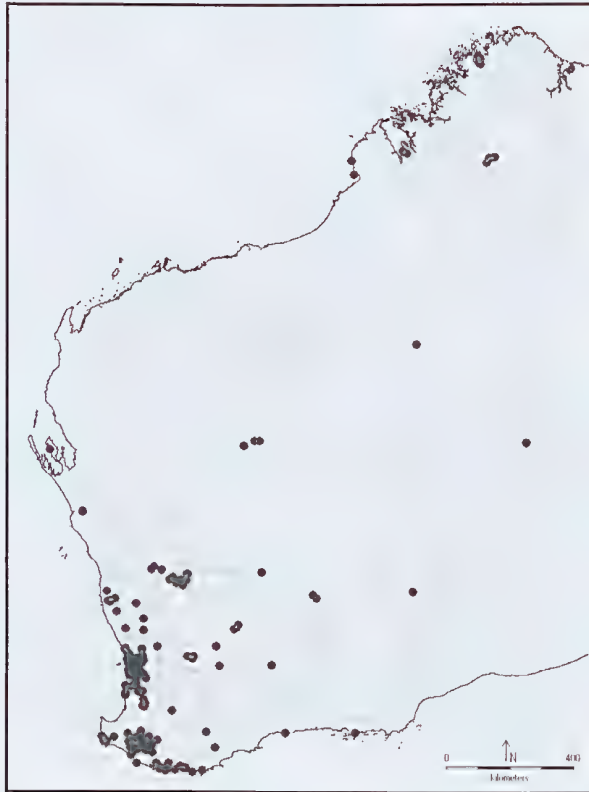


Figure 2. Distribution of Western Australian slime mould accessions housed at the Western Australian Herbarium. Version 6.1 IBRA subregions (Department of the Environment, Water, Heritage and the Arts 2008) are indicated in grey.



can be measured. It is hoped that this census will provide a further stimulus for collections of slime mould specimens in Western Australia. At this early stage in slime mould interest in Western Australia, nearly every specimen lodged at PERTH will provide valuable information.

## Methods

This census lists the names of all currently recognised species of Myxomycota for Western Australia. The records are based on published literature records and specimens lodged at PERTH. Included in the listing is the accepted name of the taxon, the author(s) name(s), details of the original publication, published literature records and the number of specimens housed at PERTH. Synonyms are not included in this publication as it has been prepared as a Census not as a nomenclatural publication. The family names follow the systematic arrangement of Hawksworth *et al.* (1995) as this is the arrangement currently used at PERTH. Within each family the species are arranged alphabetically. Nomenclature complies with that given by Lado (2001) and Hernandez-Crespo and Lado (2005), but has been updated to incorporate subsequent nomenclatural acts approved recently by the Committee for Fungi (Gams 2005). Author abbreviations follow Brummitt and Powell (1992) or when not included in that work, are abbreviated using the same criteria. Journal titles are abbreviated in accordance with Stafleu and Cowan (1988), except that upper case initial letters are used for proper names and significant words. Other literature is abbreviated in accordance with Lawrence *et al.* (1968) and Bridson and Smith (1991).

## Western Australian Myxomycota census

### Clastodermataceae

**Clastoderma debaryanum** A.Blytt, *Bot. Zeitung (Berlin)* 38: 343 (1880).

McHugh *et al.* (2009: 58, as *Clastoderma debaryanum* var. *debaryanum*).

Represented by four specimens at PERTH.

-44

### Echinosteliaceae

**Echinostelium apitectum** K.D.Whitney, *Mycologia* 72: 954 (1980).

McHugh *et al.* (2003: 491, as *Echinostelium vanderpoelii*).

Represented by three specimens at PERTH.

**Echinostelium bisporum** (L.S.Olive & Stoian.) K.D.Whitney & L.S.Olive, in Whitney, Bennett & Olive, *Mycologia* 74: 680 (1982).

McHugh *et al.* (2009: 58).

Not represented at PERTH.

**Echinostelium corynophorum** K.D. Whitney, *Mycologia* 72: 963 (1980).

McHugh *et al.* (2003: 490); McHugh *et al.* (2009: 58).

Not represented at PERTH.

**Echinostelium elachiston** Alexop., *Mycologia* 50: 52 (1958).

Jordan *et al.* (2006: 360).

Represented by one specimen at PERTH.

**Echinostelium minutum** de Bary, in Rostafinsky, *Vers. Syst. Mycetozoen* 7 (1873).

Mitchell (1995: 272); McHugh *et al.* (2003: 491); Jordan *et al.* (2006: 360).

Represented by five specimens at PERTH.

### **Cribrariaceae**

**Cribraria argillacea** (Pers.) Pers., in Roemer, *Neu. Mag. Bot.* 1: 91 (1794).

Represented by one specimen at PERTH.

**Cribraria aurantiaca** Schumach., *Enum. Pl.* 2: 218 (1803).

Represented by one specimen at PERTH.

**Cribraria cancellata** (Batsch) Nann.-Bremek., *Nederlandse Myxomyceten (Amsterdam)* 92 (1975) [1974].

McHugh *et al.* (2003: 491, as *Cribraria cancellata* var. *fusca*); McHugh *et al.* (2009: 58).

Represented by nine specimens at PERTH.

**Cribraria microcarpa** (Schröd.) Pers., *Syn. Meth. Fung.* 190 (1801).

Represented by three specimens at PERTH.

**Cribraria minutissima** Schwein., *Trans. Amer. Philos. Soc.*, N.S. 4: 260 (1832).

McHugh *et al.* (2003: 491); Jordan *et al.* (2006: 360).

Represented by ten specimens at PERTH.

**Cribraria mirabilis** (Rostaf.) Masee, *Monogr. Myxogastr.* 60 (1892).

Represented by one specimen at PERTH.

**Cribraria rufa** (Roth) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 6(1): 232 (1875).

Represented by three specimens at PERTH.

**Cribraria tenella** Schrad., *Nov. Gen. Pl.* 6 (1797).

Represented by two specimens at PERTH.

**Cribraria violacea** Rex, *Proc. Acad. Nat. Sci. Philadelphia* 43: 393 (1891).

McHugh *et al.* (2009: 58).

Represented by two specimens at PERTH.

## Liceaceae

**Licea biformis** Morgan, *J. Cincinnati Soc. Nat. Hist.* 15: 131 (1893).

McHugh *et al.* (2003: 491); McHugh *et al.* (2009: 59).

Represented by one specimen at PERTH.

**Licea denudescens** H.W.Keller & T.E.Brooks, *Mycologia* 69: 679 (1977).

McHugh *et al.* (2003: 492).

Not represented at PERTH.

**Licea glocloderma** Döbbeler & Nann.-Bremek., *Z. Mykol.* 45: 235 (1979).

Represented by one specimen at PERTH.

**Licea kleistobolus** G.W.Martin, *Mycologia* 34: 702 (1942).

Mitchell (1995: 273); McHugh *et al.* (2003: 492); Jordan *et al.* (2006: 360).

Represented by nine specimens at PERTH.

**Licea minima** Fr., *Syst. Mycol.* 3: 199 (1829).

Represented by two specimens at PERTH.



**Licea operculata** (Wingate) G.W.Martin, *Mycologia* 34: 702 (1942).

McHugh *et al.* (2003: 492).

Represented by one specimen at PERTH.

**Licea parasitica** (Zukal) G.W.Martin, *Mycologia* 34: 702 (1942)

Mitchell (1995: 273)

Not represented at PERTH

**Licea pedicillata** (H.C.Gilbert) H.C.Gilbert, *Mycologia* 34: 702 (1942).

Mitchell (1995: 273).

Not represented at PERTH.

**Licea pusilla** Schrad., *Nov. Gen. Pl.* 19 (1797).

McHugh *et al.* (2003: 492).

Represented by one specimen at PERTH.

**Licea pygmaea** (Meyl.) Ing, *Trans. Brit. Mycol. Soc.* 78: 443 (1982).

Represented by two specimens at PERTH.

**Licea rufocuprea** Nann.-Bremek. & Y.Yamam., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 90(3): 325 (1987).

McHugh *et al.* (2003: 492).

Represented by one specimen at PERTH.

## **Lycogalaceae**

**Dictydiaethalium plumbeum** (Schumach.) Rostaf. ex Lister, *Monogr. Mycetozoa* 157 (1894).

Cooke (1892: 393, as *Clathroptychium rugulosum*); MacAlpine (1895: 194); Cheeseman & Lister (1915: 207); Mitchell (1995: 273).

Not represented at PERTH.

**Lycogala conicum** Pers., *Syn. Meth. Fung.* 159 (1801).

Represented by one specimen at PERTH.

**Lycogala epidendrum** (L.) Fr., *Syst. Mycol.* 3: 80 (1829).

Cooke (1892: 396); MacAlpine (1895: 194); Hnatiuk (1978: 17); Mitchell (1995: 273).

Represented by 15 specimens at PERTH.

**Reticularia intermedia** Nann.-Bremek., *Acta Bot. Neerl.* 7: 773 (1958).

Represented by one specimen at PERTH.

**Reticularia lycoperdon** Bull., *Hist. Champ. France* 1: 95 (1791).

Mitchell (1995: 274).

Represented by two specimens at PERTH.

**Reticularia olivacea** (Ehrenb.) Fr., *Syst. Mycol.* 3: 89 (1829).

MacAlpine (1895: 194, as *Enteridium olivaceum*); Cooke (1892: 393, as *E. olivaceum*); Mitchell (1995: 274).

Represented by one specimen at PERTH.

**Tubifera ferruginosa** (Batsch) J.F.Gmel., *Syst. Nat. pars* 2, 1472 (1792).

Represented by four specimens at PERTH.

## Didymiaceae

-44

**Diderma asteroides** (Lister & G.Lister) G.Lister, in Lister, *Monogr. Mycetozoa*, Ed. 2, 113 (1911).

Represented by two specimens at PERTH.

**Diderma cinereum** Morgan, *J. Cincinnati Soc. Nat. Hist.* 16: 154 (1894).

Represented by one specimen at PERTH.

**Diderma crustaceum** Peck, *Ann. Rep. New York State Mus. Nat. Hist.* 26: 74 (1874).

Represented by one specimen at PERTH.

**Diderma effusum** (Schwein.) Morgan, *J. Cincinnati Soc. Nat. Hist.* 16: 155 (1894).

Ing & Spooner (1994: 74); McHugh *et al.* (2003: 495).

Represented by one specimen at PERTH.

**Diderma hemisphaericum** (Bull.) Hornem., *Fl. Danic.* 33: 13 (1829).

McHugh *et al.* (2003: 495).

Represented by one specimen at PERTH.

**Diderma saundersii** (Berk. & Broome ex Massee) Ladó, *Cuad. Trab. Fl. Micol. Iber.* 16: 35(2001).

McHugh *et al.* (2003: 495, as *Diderma saundersii* var. *berkeleyanum*).

Represented by one specimen at PERTH.

**Diderma spumarioides** (Fr.) Fr., *Syst. Mycol.* 3: 104 (1829).

Ing & Spooner (1994: 74).

Not represented at PERTH.

**Didymium anellus** Morgan, *J. Cincinnati Soc. Nat. Hist.* 16: 148 (1894).

McHugh *et al.* (2009: 61).

Represented by one specimen at PERTH.

**Didymium bahiense** Gottsb., *Nova Hedwigia* 15: 365 (1968).

Ing & Spooner (1994: 74); McHugh *et al.* (2003: 495).

Represented by three specimens at PERTH.

**Didymium clavus** (Alb. & Schwein.) Rabenh., *Deutschl. Krypt.-Fl.* 1: 280 (1844).

Represented by one specimen at PERTH.

**Didymium difforme** (Pers.) Gray, *Nat. Arr. Brit. Pl.* 1: 571 (1821).

Ing & Spooner (1994: 74).

Represented by five specimens at PERTH.



**Didymium dubium** Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 5(4): 152 (1874).

Represented by one specimen at PERTH

**Didymium floccosum** G.W.Martin, K.S.Thind & Rehill, *Mycologia* 51: 160 (1959)

Ing & Spooner (1994: 74).

Not represented at PERTH.

**Didymium intermedium** J.Schröt., *Hedwigia* 35: 209 (1896).

Ing & Spooner (1994: 73).

Not represented at PERTH.

**Didymium megalosporum** Berk. & M.A.Curtis, *Grevillea* 2: 53 (1873).

Represented by one specimen at PERTH.

**Didymium minus** (Lister) Morgan, *J. Cincinnati Soc. Nat. Hist.* 16: 145 (1894).

McHugh *et al.* (2009: 61).

Not represented at PERTH.

**Didymium perforatum** Yamash., *J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot.* 3: 33 (1936).

Represented by one specimen at PERTH.

**Didymium serpula** Fr., *Syst. Mycol.* 3: 126 (1829).

Ing & Spooner (1994: 74).

-84

Represented by three specimens at PERTH.

**Didymium squamulosum** (Alb. & Schwein.) Fr., *Symb. Gasteromyc.*, Fasc. 1-3: 19 (1818).

Ing & Spooner (1994: 74).

Represented by four specimens at PERTH.

**Didymium verrucosporum** A.L.Welden, *Mycologia* 46: 98 (1954).

Represented by one specimen at PERTH.

**Physaraceae**

**Badhamia capsulifera** (Bull.) Berk., *Trans. Linn. Soc. London* 21: 153 (1853).

Represented by one specimen at PERTH.

**Badhamia foliicola** Lister, *J. Bot.* 35: 209 (1897).

McHugh *et al.* (2009: 60).

Represented by five specimens at PERTH.

**Badhamia goniospora** Meyl., *Bull. Soc. Vaudoise Sci. Nat.* 56: 66 (1925).

Represented by one specimen at PERTH.

**Badhamia panicea** (Fr.) Rostaf., in Fuckel, *Jahrb. Nassauischen Vereins Naturk.* 27–28: 71 (1873).

Represented by one specimen at PERTH.

**Badhamia utricularis** (Bull.) Berk., *Trans. Linn. Soc. London* 21: 153 (1853).

Represented by one specimen at PERTH.

**Badhamia versicolor** Lister, *J. Bot.* 39: 81 (1901).

Represented by one specimen at PERTH.

**Craterium aureum** (Schumach.) Rostaf., *Pamięt. Towarz. Nauk. Sci. Paryzu* 5(4): 124 (1874).

Represented by one specimen at PERTH.

**Craterium leucocephalum** (Pers.) Ditmar, in Sturm, *Deutschl. Fl.* 1: 21 (1813).

McHugh *et al.* (2009: 60).

Represented by two specimens at PERTH.

**Craterium minutum** (Leers) Fr., *Syst. Mycol.* 3: 151 (1829).

Cooke (1892: 404, as *Craterium confusum*); MacAlpine (1895: 198, as *C. confusum*); Cheeseman & Lister (1915: 207); Mitchell (1995: 282).

Represented by two specimens at PERTH.

**Fuligo cinerea** (Schwein.) Morgan, *J. Cincinnati Soc. Nat. Hist.* 19: 33 (1896).

Mitchell (1995: 282).

Represented by two specimens at PERTH.

**Fuligo megaspora** Sturgis, *Colorado Coll. Stud., Sci. Ser.* 12: 443 (1913).

Represented by one specimen at PERTH.

**Fuligo septica** (L.) F.H.Wigg., *Prim. Fl. Holsat.* 112 (1780).

Cooke (1892: 408, as *Fuligo varians*); MacAlpine (1895: 198, as *F. varians*); Cleland (1927: 62, as *F. candida*: 63, as *F. candida* var. *candida*); Mitchell (1995: 282).

Represented by 20 specimens at PERTH.

**Leocarpus fragilis** (Dicks.) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 5(4): 132 (1874).

McHugh *et al.* (2003: 495, as *Leocarpus fragilis* var. *fragilis*).

Represented by eight specimens at PERTH.

**Physarum album** (Bull.) Chevall., *Fl. Gén. Env. Paris* 1: 336 (1826).

Cooke (1892: 407, as *Tilmadoche nutans*); MacAlpine (1895: 198, as *T. nutans*); Cheeseman & Lister (1915: 207, as *Physarum nutans*); Hnatiuk (1978: 17, as *P. nutans*); Hnatiuk & Kenneally (1981: 53, as *P. nutans*); Mitchell (1995: 287, as *P. nutans*).

Represented by two specimens at PERTH.

**Physarum bitectum** G.Lister, *Monogr. Mycetozoa*, Ed. 2, 78 (1911).

Ing & Spooner (1994: 75).

Represented by two specimens at PERTH.

**Physarum bivalve** Pers., *Ann. Bot. (Usteri)* 15: 5 (1795).

Ing & Spooner (1994: 75).

Represented by one specimen at PERTH.



**Physarum brunneolum** (W.Phillips) Massee, *Monogr. Myxogastr.* 280 (1892).

Ing & Spooner (1994: 75).

Not represented at PERTH.

**Physarum cinereum** (Batsch) Pers., in Roemer, *Neu. Mag. Bot.* 1: 89 (1794).

Cooke (1892: 406, as *Physarum scrobiculatum*); MacAlpine (1895: 198, as *Physarum cinereum* and *P. scrobiculatum*); Cheeseman & Lister (1915: 207); Ing & Spooner (1994: 75); Mitchell (1995: 284).

Represented by 7 specimens at PERTH.

**Physarum citrinum** Schumach., *Enum. Pl.* 2: 201 (1803).

Represented by one specimen at PERTH.

**Physarum compressum** Alb. & Schwein., *Consp. Fung. Lusat.* 97 (1805).

Represented by four specimens at PERTH.

**Physarum conglomeratum** (Fr.) Rostaf., *Pamięt. Towarz. Nauk. Sci. Paryzu* 5(4): 108 (1874).

Represented by one specimen at PERTH.

**Physarum crateriforme** Petch, *Ann. Roy. Bot. Gard. Peradeniya* 4: 304 (1909).

McHugh *et al.* (2003: 495, as *Physarum crateriforme* var. *columellatum*).

Not represented at PERTH.

**Physarum daamsii** Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 74(4): 363 (1971).

Represented by one specimen at PERTH.

**Physarum decipiens** M.A.Curtis, *Amer. J. Sci. Arts*, Ser. 2, 6: 352 (1848).

Represented by one specimen at PERTH.

**Physarum famintzinii** Rostaf., *Pamięt. Towarz. Nauk. Sci. Parzyu* 5(4): 107 (1874).

McHugh *et al.* (2003: 496).

Represented by one specimen at PERTH.

**Physarum flavicomum** Berk., *London J. Bot.* 4: 66 (1845).

Cooke (1892: 403, as *Didymium flavicomum*); MacAlpine (1895: 196, as *D. flavicomum*); Cheesman & Lister (1915: 207); Mitchell (1995: 286).

Not represented at PERTH.

**Physarum leucophaeum** Fr., *Symb. Gasteromyc.*, Fasc. 1-3: 24 (1818).

Represented by one specimen at PERTH.

**Physarum luteolum** Peck, *Ann. Rep. New York State Mus. Nat. Hist.* 30: 50 (1878).

Represented by one specimen at PERTH.

**Physarum melleum** (Berk. & Broome) Masee, *Monogr. Myxogastr.* 278 (1892).

Represented by three specimens at PERTH.

**Physarum nudum** T.Macbr., in Peck & Gilbert, *Amer. J. Bot.* 19: 134 (1932).

Mitchell (1995: 286).

Represented by one specimen at PERTH.

**Physarum pusillum** (Berk. & M.A.Curtis) G.Lister, in Lister, *Monogr. Mycetozoa*, Ed. 2, 64 (1911).

McHugh *et al.* (2003: 496).

Represented by eight specimens at PERTH.

**Physarum robustum** (Lister) Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 76(5): 484 (1973).

Represented by one specimen at PERTH.

**Physarum sessile** Brândză, *Ann. Sci. Univ. Jassy* 11: 116 (1921).

Represented by one specimen at PERTH.

**Physarum straminipes** Lister, *J. Bot.* 36: 163 (1898).

Represented by one specimen at PERTH.

**Physarum vernum** Sommerf., in Fries, *Syst. Mycol.* 3: 146 (1829).

McHugh *et al.* (2003: 496).

Represented by two specimens at PERTH.

**Physarum viride** (Bull.) Pers., *Ann. Bot. (Usteri)* 15: 6 (1795).

Cooke (1892: 407, as *Tilmadoche mutabilis*); MacAlpine (1895: 198, as *T. mutabilis*); Hnatiuk (1978: 17, as *Physarum nutans*); Mitchell (1995: 287).

Represented by 23 specimens at PERTH.

**Willkommlangea reticulata** (Alb. & Schwein.) Kuntze, *Revis. Gen. Pl.* 2: 875 (1891).

McHugh *et al.* (2009: 62).

Represented by four specimens at PERTH.

### Stemonitidaceae

**Collaria arcyronema** (Rostaf.) Nann.-Bremek. ex Lado, *Ruizia* 9: 26 (1991).

Jordan *et al.* (2006: 360).

Represented by three specimens at PERTH.

**Colloderma oculatum** (C.Lippert) G.Lister, *J. Bot.* 48: 312 (1910).

Represented by two specimens at PERTH.

**Comatricha elegans** (Racib.) G.Lister, *Guide Brit. Mycetozoa*, Ed. 3, 31 (1909).

McHugh *et al.* (2003: 497); Jordan *et al.* (2006: 360).

Represented by 19 specimens at PERTH.

**Comatricha ellae** Härk., *Karstenia* 18: 23 (1978).

Jordan *et al.* (2006: 360).

Represented by nine specimens at PERTH.



**Comatricha laxa** Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 5(4): 201 (1874).

McHugh *et al.* (2003: 497); McHugh *et al.* (2009: 62).

Represented by two specimens at PERTH.

**Comatricha longipila** Nann.-Bremek., *Acta Bot. Neerl.* 11: 31 (1962).

Represented by one specimen at PERTH.

**Comatricha nigra** (Pers.) J.Schröt., in Cohn, *Krypt.-Fl. Schlesien* 3: 118 (1885).

Hnatiuk (1978: 17); Mitchell (1995: 291); Jordan *et al.* (2006: 360).

Represented by five specimens at PERTH.

**Comatricha pulchella** (C.Bab.) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 8(4): 27 (1876).

McHugh *et al.* (2009: 62).

Represented by two specimens at PERTH.

**Comatricha pulchelloides** Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 88(1): 125 (1985).

Represented by one specimen at PERTH.

**Comatricha rigidireta** Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 69(3): 352 (1966).

Jordan *et al.* (2006: 360).

Represented by one specimen at PERTH.

**Comatricha tenerrima** (Berk. & M.A.Curtis) G.Lister, *Guide Brit. Mycetozoa*, Ed. 4, 39 (1919).

McHugh *et al.* (2009: 62).

Represented by one specimen at PERTH.

**Comatricha vineatilis** Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 92(4): 505 (1989).

Represented by one specimen at PERTH.

**Diachea leucopodia** (Bull.) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 5(4): 190 (1874).

Hnatiuk (1978: 17); Mitchell (1995: 288).

Represented by 12 specimens at PERTH.

**Diachea radiata** G.Lister & Petch, *J. Bot.* 54: 130 (1916).

Ing & Spooner (1994: 73).

Represented by one specimen at PERTH.

**Enerthenema papillatum** (Pers.) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 8(4): 28 (1876).

McHugh *et al.* (2003: 497); Jordan *et al.* (2006: 360).

Represented by 11 specimens at PERTH.

**Lamproderma collinsii** T.N.Lakh. & Mukerji, *Kavaka* 6: 9 (1979).

Represented by one specimen at PERTH.

**Lamproderma scintillans** (Berk. & Broome) Morgan, *J. Cincinnati Soc. Nat. Hist.* 16: 131 (1894).

Represented by two specimens at PERTH.

**Macbrideola cornea** (G.Lister & Cran) Alexop., *Mycologia* 59: 112 (1967).

Represented by one specimen at PERTH.

**Macbrideola decapillata** H.C.Gilbert, *Stud. Nat. Hist. Iowa Univ.* 16: 158 (1934).

Represented by one specimen at PERTH.

**Macbrideola martinii** (Alexop. & Beneke) Alexop., *Mycologia* 59: 114 (1967).

Represented by one specimen at PERTH.

**Macbrideola oblonga** Pando & Lado., *Mycotaxon* 31: 302 (1988).

Represented by two specimens at PERTH.

**Paradiachea caespitosa** (Sturgis) Hertel ex H.Neubert, Nowotny & K. Baumann, *Myxomyceten* 3: 249 (2000).

McHugh *et al.* (2003: 497).

Represented by one specimen at PERTH.

**Paradiacheopsis fimbriata** (G.Lister & Cran) Hertel ex Nann.-Bremek., *Nederlandse Myxomyceten* 232 (1975).

McHugh *et al.* (2003: 497); Jordan *et al.* (2006: 360).

Represented by 15 specimens at PERTH.

**Paradiacheopsis rigida** (Brândză) Nann.-Bremek., in Martin & Alexopoulos, *Myxomycetes (New York)* 231 (1969).

Jordan *et al.* (2006: 360).

Not represented at PERTH.

**Stemonitis fusca** Roth, in Roemer & Usteri, *Mag. Bot.* 1(2): 26 (1788).

Cooke (1892: 393); MacAlpine (1895: 194); Hnatiuk (1978: 17); Mitchell (1995: 292).

Represented by six specimens at PERTH.

**Stemonitis herbatica** Peck, *Ann. Rep. New York State Mus. Nat. Hist.* 26: 75 (1874).

Cheeseman & Lister (1915: 207); Mitchell (1995: 293).

Not represented at PERTH.

**Stemonitis laxifila** Nannen.-Bremek. & Y.Yamam., in Watanabe & Malla. *Crypt. Himalayas* 1: 9 (1988).

Represented by one specimen at PERTH.

**Stemonitis lignicola** Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 76(5): 478 (1973).

Represented by three specimens at PERTH.

**Stemonitis smithii** T.Macbr., *Bull. Iowa Univ. Lab. Nat. Hist.* 2: 381 (1893).

Represented by one specimen at PERTH.



**Stemonitis splendens** Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 5(4): 195 (1874).

Ing & Spooner (1994: 75).

Represented by four specimens at PERTH.

**Stemonitis virginiensis** Rex, *Proc. Acad. Nat. Sci. Philadelphia* 43: 391 (1891).

Represented by two specimens at PERTH.

**Stemonitopsis amoena** (Nann.-Bremek.) Nann.-Bremek., *Nederlandse Myxomyceten* 205 (1975).

Jordan *et al.* (2006: 360).

Represented by two specimens at PERTH.

**Stemonitopsis gracilis** (G.Lister) Nann.-Bremek., *Nederlandse Myxomyceten* 210 (1975).

Represented by two specimens at PERTH.

**Stemonitopsis peritricha** Nann.-Bremek., *Nederlandse Myxomyceten* 212 (1975).

Represented by one specimen at PERTH.

**Stemonitopsis reticulata** (H.C.Gilbert) Nann.-Bremek. & Y.Yamam., in Yamamoto & Nannenga-Bremekamp, *Proc. Kon. Ned. Akad. Wetensch., Ser. C*, 98(3): 325 (1995).

Represented by one specimen at PERTH.

**Stemonitopsis typhina** (F.H.Wigg.) Nann.-Bremek., *Nederlandse Myxomyceten* 209 (1975).

Cheeseman & Lister (1915: 203, 207, 210 as *Comatricha typhoides*); Mitchell (1995: 294).

Represented by six specimens at PERTH.

**Symphytocarpus amaurochaetoides** Nann.-Bremek., in Ing & Nannenga-Bremekamp, *Proc. Kon. Ned. Akad. Wetensch., Ser. C*, 70(2): 218 (1967).

Ing & Spooner (1994: 75).

Not represented at PERTH.

**Arcyriaceae**

**Arcyria affinis** Rostaf., *Pamięt. Towarz. Nauk. Sci. Paryzu* 6(1): 276 (1875).

Represented by one specimen at PERTH.

**Arcyria cinerea** (Bull.) Pers., *Syn. Meth. Fung.* 184 (1801).

Hnatiuk (1978: 17); Hnatiuk & Kenneally (1981: 53); Ing & Spooner (1994: 73); Mitchell (1995: 276); McHugh *et al.* (2003: 492).

Represented by 11 specimens at PERTH.

**Arcyria denudata** (L.) Wettst., *Vorarb. Pilzfl. Steiermark* 1: 9 (1885).

Represented by three specimens at PERTH.

**Arcyria ferruginea** Saut., *Flora* 24: 316 (1841).

Represented by two specimens at PERTH.

**Arcyria incarnata** (J.F.Gmel.) Pers., *Observ. Mycol.* 1: 58 (1796).

Cooke (1892: 398); MacAlpine (1895: 196); Cheesman & Lister (1915: 208); Mitchell (1995: 277).

Represented by four specimens at PERTH.

**Arcyria insignis** Kalchbr. & Cooke, in Kalchbrenner, *Grevillea* 10: 143 (1882).

Ing & Spooner (1994: 73).

Represented by one specimen at PERTH.

**Arcyria minuta** Buchet, in Patouillard, *Mém. Acad. Malgache* 6: 42 (1927).

Mitchell (1995: 277).

Represented by five specimens at PERTH.

**Arcyria obvelata** (Oeder) Onsberg, *Mycologia* 70: 1286 (1979).

Cooke (1892: 398, as *Arcyria nutans*); MacAlpine (1895: 196, as *A. nutans*); Hnatiuk (1978: 17, as *A. nutans*); Mitchell (1995: 277, as *A. nutans*); McHugh *et al.* (2003: 493, as *A. nutans*).

Represented by 11 specimens at PERTH.

**Arcyria occidentalis** (T.Macbr.) G.Lister, in Lister, *Monogr. Mycetozoa*, Ed. 2, 245 (1911).

Represented by one specimen at PERTH.

**Arcyria pausiaca** H.W.Keller & Bub.-Zurey, in Keller, Whitney & Buben-Zurey, *Mycologia* 78: 433 (1986).

Represented by four specimens at PERTH.

**Arcyria pomiformis** (Leers) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 6(1): 271 (1875).

Ing & Spooner (1994: 73); McHugh *et al.* (2003: 493); Jordan *et al.* (2006: 360).

Represented by 11 specimens at PERTH.

**Arcyria stipata** (Schwein.) Lister, *Monogr. Mycetozoa* 189 (1894).

Represented by two specimens at PERTH.

### **Dianemataceae**

**Calomyxa metallica** (Berk.) Nieuwl., *Amer. Midl. Natural.* 4: 335 (1916).

McHugh *et al.* (2003: 493); McHugh *et al.* (2009: 59).

Represented by one specimen at PERTH.

**Dianema corticatum** Lister, *Monogr. Mycetozoa* 205 (1894).

Represented by one specimen at PERTH.

### **Trichiaceae**

**Hemitrichia calyculata** (Speg.) M.L.Farr, *Mycologia* 66: 887 (1974).

Represented by one specimen at PERTH.

**Hemitrichia minor** G.Lister, *J. Bot.* 49: 62 (1911).

Mitchell (1995: 279, as *Perichaena minor*).

Represented by one specimen at PERTH.



**Hemitrichia serpula** (Scop.) Rostaf., in Lister, *Monogr. Mycetozoa*, Ed. 1, 179 (1894).

Cooke (1892: 399, as *Arcyria serpula*); MacAlpine (1895: 196, as *A. serpula*); Hnatiuk & Kenneally (1981: 54); Mitchell (1995: 278).

Not represented at PERTH.

**Metatrichia floriformis** (Schwein.) Nann.-Bremek., *Proc. Kon. Ned. Akad. Wetensch.*, Ser. C, 88(1): 127 (1985).

Represented by four specimens at PERTH.

**Oligonema schweinitzii** (Berk.) G.W.Martin, *Mycologia* 39: 460 (1947).

Represented by four specimens at PERTH.

**Perichaena corticalis** (Batsch) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 6(1): 293 (1875).

Cooke (1892: 395); MacAlpine (1895: 194); Mitchell (1995: 278); McHugh *et al.* (2009: 60, as *Perichaena corticalis* var. *corticalis*).

Represented by eight specimens at PERTH.

**Perichaena depressa** Lib., *Pl. Crypt. Arduenna* 4: 378 (1837).

Hnatiuk & Kenneally (1981: 54); Mitchell (1995: 279).

Represented by eight specimens at PERTH.

**Perichaena vermicularis** (Schwein.) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 8(4): 34 (1876).

McHugh *et al.* (2003: 494).

Represented by three specimens at PERTH.

**Trichia affinis** de Bary, in Fuckel, *Jahrb. Nassauischen Vereins Naturk.* 23-24: 336 (1869).

Mitchell (1995: 279).

Represented by eight specimens at PERTH.

**Trichia botrytis** (J.F.Gmel.) Pers., in Roemer, *Neu. Mag. Bot.* 1: 89 (1794).

Cooke (1892: 399, as *Trichia fragilis*); MacAlpine (1895: 196, as *T. fragilis*); Mitchell (1995: 279).

Represented by two specimens at PERTH.

**Trichia contorta** (Ditmar) Rostaf., *Pamiet. Towarz. Nauk. Sci. Paryzu* 6(1): 259 (1875).

McHugh *et al.* (2009: 60).

Represented by four specimens at PERTH.

**Trichia decipiens** (Pers.) T.Macbr., *N. Amer. Slime-Moulds* 218 (1899).

Mitchell (1995: 280).

Represented by 12 specimens at PERTH.

**Trichia favoginea** (Batsch) Pers., in Roemer, *Neu. Mag. Bot.* 1: 90 (1794).

Hnatiuk (1978: 17); Mitchell (1995: 280).

Represented by 12 specimens at PERTH.

**Trichia munda** (Lister) Meyl., *Bull. Soc. Vaud. Sci. Nat.* 56: 327 (1927).

Represented by one specimen at PERTH.

**Trichia persimilis** P.Karst., *Not. Sällsk. Fauna Fl. Fenn. Förh.* 9: 353 (1868).

Represented by nine specimens at PERTH.

**Trichia varia** (J.F.Gmel.) Pers., in Roemer, *Neu. Mag. Bot.* 1: 90 (1794).

McHugh *et al.* (2009: 60).

Represented by six specimens at PERTH.

**Trichia verrucosa** Berk., in Hooker, *Fl. Tasm.* 2: 269 (1859).

McHugh *et al.* (2003: 494).

Represented by three specimens at PERTH.

### **Ceratiomyxaceae**

**Ceratiomyxa fruticulosa** (O.F.Müll.) T.Macbr., *N. Amer. Slime-Moulds* 18 (1889)

Mitchell (1995: 271); McHugh *et al.* (2003: 490, as *Famintzinia fruticulosa*)

Represented by ten specimens at PERTH.

## Acknowledgements

Thank you to David W. Mitchell, J.P.M. van Hooff, Roland McHugh, Steven Stephenson and Elaine Davison for their unwavering assistance from the very beginning of our slime mould journey; and to the staff of the Western Australian Herbarium who enthusiastically brought in all sorts of things which they hadn't noticed in the field previously. We would also like to thank Juliet Wege, Terry Macfarlane for their encouragement and constructive comments on the draft, and Kevin Thiele, Louise Biggs and Claire Ellis for their technical input, and Neale Bougher and Peter Davison for providing images.

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## Two new taxa of *Verticordia* (Myrtaceae: Chamelaucieae) from south-western Australia

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### Abstract

George, A.S. and Barrett, M.D. Two new taxa of *Verticordia* (Myrtaceae: Chamelaucieae) from south-western Australia. *Nuytsia* 20: 309–318 (2010). *Verticordia mitchelliana* subsp. *implexior* A.S. George & M.D. Barrett and *Verticordia setacea* A.S. George are described and discussed. *Verticordia setacea* belongs with *V. gracilis* A.S. George in section *Platandra*, previously a monotypic section.

### Introduction

The genus *Verticordia* DC. (Myrtaceae: tribe Chamelaucieae) is a charismatic group of shrubs found mainly in south-western Australia, with several species in adjacent arid regions and three in tropical Australia (George 1991; George & Pieroni 2002). *Verticordia* is currently defined solely on the possession of divided calyx lobes, but the limits between *Verticordia* and the related genera *Homoranthus* A.Cunn. ex Schauerr, *Chamelaucium* Desf. and *Darwinia* Rudge are difficult to define conclusively, and other characteristics such as anther morphology suggest conflicting relationships (Bentham 1867; Craven & Jones 1991; George 1991). A recent analysis using a single chloroplast gene, with limited sampling of *Verticordia* taxa (Ma *et al.* 2002), suggests that *Verticordia* may be polyphyletic. A thorough phylogenetic analysis of the group of genera around *Chamelaucium* is overdue.

During a molecular phylogenetic study of *Verticordia*, one of us (MB) noticed unusual levels of genetic divergence between samples of *Verticordia mitchelliana* C.A. Gardner. Multiple samples were taken to cover the geographic range of the species as defined by George (1991) and George and Pieroni (2002), particularly focusing on samples either side of the geographic disjunction in this species (see map in George & Pieroni 2002). The recovery of apparently fixed genetic differences prompted a morphological revision of *V. mitchelliana*, resulting in the discovery of several previously overlooked morphological characters correlating with both the genetic data and the geographic disjunction. A new subspecies is erected here to formally recognise that variation.

Concurrently, during finalisation of a treatment of *Verticordia* for *Flora of Australia* (George, in preparation), some variation was noted in inflorescence structure and floral morphology in different populations of *V. gracilis* A.S. George, initiating a review of the taxonomy of this species; a new species is described here to accommodate this variation.

As the publication of the account of *Verticordia* for *Flora of Australia*, and full publication of all molecular analyses (Barrett, in preparation) is some time off, the new taxa are described here to facilitate their conservation. The new species and *V. mitchelliana* subsp. *mitchelliana* are conservation-listed taxa for south-western Australia. The genus *Verticordia* (sens. lat.) now contains 102 species and (including autonyms) 26 subspecies and 47 varieties, of which 46 species and 27 infraspecific taxa have formal conservation status in Western Australia.

Methods

This work is based on a morphological study of herbarium material. Methods, taxonomic concepts and terminology follow those outlined in George (1991). As in all genera, especially sizeable ones, assessment of useful characters and states comes from extensive study of the plants, as was done by George for his review of the genus (George 1991). *Verticordia* is especially rich in useful characters of vegetative and floral parts. An understanding of these underpins the assessment of ranking into subgenera, species, subspecies (which also includes a component of geographical disjunction) and variety. For dissection, flowers were softened in a mild detergent solution. Dimensions of flowers so treated are the same as in the fresh state.

**Verticordia mitchelliana**, C.A.Gardner, *J. Roy. Soc. Western Australia* 19: 89 (1933).

*Typus*: Avon district, near Bencubbin, [Western Australia], October 1929, James Mitchell s.n. (*holo*: PERTH 01623516; *iso*: K, PERTH 01623524).

A *shrub* to 1 m without lignotuber, widely branched. *Stem leaves* linear, semiterete, obtuse, 6–15 mm long; floral leaves similar. *Flowers* pendulous, in open raceme-like groups, not scented. *Peduncles* 4–16 mm long. *Bracteoles* not keeled, not cuspidate, caducous. *Hypanthium* turbinate, much expanded above, 3 mm long, not ribbed, smooth to slightly verrucose, glabrous except basal ring of hairs and sometimes a ring around the middle; a swelling below each sepal. *Sepals* 7–9 mm long, spreading, bright red; lobes 6 or 7, deeply and divaricately divided; auricles reflexed, divaricately divided. *Petals* 7–11 mm long, ovate-oblong, fimbriate across apex, erect, shortly pubescent outside, creamy-pink at first, turning bright red. *Stamens and staminodes* shortly united; stamens ± uniform, erect with inflexed anthers, 2–3 mm long; filaments slightly compressed, smooth, glabrous; anthers globular, 0.7 mm long; appendage a small apical swelling. *Staminodes* inserted outside stamens, linear-subulate, 3–5 mm long, ± glandular-verrucose. *Style* 24–29 mm long, straight, sparsely bearded with short simple hairs; stigma slightly enlarged. *Ovules* 2.

*Verticordia mitchelliana* has a disjunct distribution, one group of populations in the north-eastern wheatbelt, the other to the south-east. DNA sequences from the External Transcribed Spacer (ETS) of nrDNA (M. Barrett unpublished data) of three samples from each taxon show three apparently fixed substitutions and two apparently fixed insertions between sequences from the two areas, with no variation between sequences within each area. Study of herbarium material reveals morphological differences that are considered sufficient to warrant recognition at subspecific rank. Although the existence of two taxa was first suggested by molecular data, the taxonomic conclusions presented here are based on morphological data alone, and the genetic evidence will be presented elsewhere.

- 1. Petals 7–8 mm long; staminodes 3–4 mm long.....subsp. **mitchelliana**
- 1: Petals 8.5–11 mm long; staminodes 4.5–5 mm long..... subsp. **implexior**



***Verticordia mitchelliana* C.A.Gardner subsp. *mitchelliana***

*Leaves* 0.5–0.8 mm wide. *Petals* 7–8 mm long, pubescent outside, fringed almost to base. *Staminodes* 3–4 mm long. *Style* ‘neck’ (between beard and stigma) 1–1.5 mm long. (Figure 1)

*Selected specimens examined.* WESTERN AUSTRALIA: [precise localities withheld for conservation reasons] 12 Oct. 2008, *J.M. Collins* 373 (PERTH); Bencubbin, Sep. 1936, *C.A. Gardner s.n.* (PERTH); Cowcowing, 9 Oct. 1963, *C.A. Gardner s.n.* (PERTH); Wyalkatchem, 20 Oct. 1963, *R.D. Royce* 7993 (PERTH); SE of Kulja, 21 Oct. 1984, *B.H. Smith* 488 (AD, CANB, HO, MEL, PERTH); Wyalcatchem, 29 Dec. 1986, *B.H. Smith* 834 (CANB, CHR, HO, MEL, PERTH).

*Distribution and habitat.* Occurs sporadically from Kulja south to Wyalcatchem and east to Bencubbin. Grows in sand over laterite, in kwongan and shrubland (Figure 2).

*Phenology.* Flowers October to December.

*Conservation status.* Conservation Codes for Western Australian Flora: recently listed as Priority Three.

*Note.* Subsp. *mitchelliana* is typically of more spreading habit than subsp. *implexior*.

***Verticordia mitchelliana* subsp. *implexior* A.S.George & M.D.Barrett, subsp. nov.**

Ab *Verticordia mitchelliana* C.A.Gardner subsp. *mitchelliana* foliis plerumque latioribus, sepalis copiosius divisus, petalibus et staminodiis longioribus, praecipue differt.

*Typus:* 25 km east of Rabbit Fence (No. 2), between Hyden and Pioneer, Western Australia, 24 Nov. 1964, *C.A. Gardner* 15010 (*holo:* PERTH 02359340; *iso:* CANB, K, MEL, PERTH 02386925)

*Leaves* 1–1.5 mm wide. *Petals* 8.5–11 mm long, ± glabrous or pubescent outside, fringed only across apex or on lateral margins. *Staminodes* 4.5–5 mm long. *Style* ‘neck’ (between beard and stigma) 0.5–1 mm long. (Figure 3)

*Selected specimens examined.* WESTERN AUSTRALIA: 61 km W of Coolgardie–Esperance Hwy on Lake King–Norseman road, 6 Oct. 2001, *B. Archer* 1987 (CANB, MEL, PERTH); 87 km E of Lake King on Lake King–Norseman Rd, 9 Oct. 1998, *S. Donaldson* 2026 & *G.T. Chandler* (CANB, PERTH); c. 150 km E of Hyden, Dec. 1956, *R.J. Donovan s.n.* (PERTH); c. 70 km E of Hyden, Dec. 1964, *A.R. Main s.n.* (PERTH); 26 km NW of Roberts Swamp, c. 50 km WNW of Grass Patch, 13 Nov. 1980, *K. Newbey* 8187 (PERTH); 54 km W of Kumarl [on Lake King–Norseman Rd], 10 Oct. 1966, *P.G. Wilson* 5699 (CANB, PERTH).

*Distribution and habitat.* Occurs from the Mt Holland area south-east to the Peak Charles area, including Frank Hann National Park. Grows in deep sand or sand over laterite, in kwongan, shrubland and mallee shrubland. A single plant recorded between Corrigin and Kulin was probably planted (Figure 2).

*Phenology.* Flowers October to December.

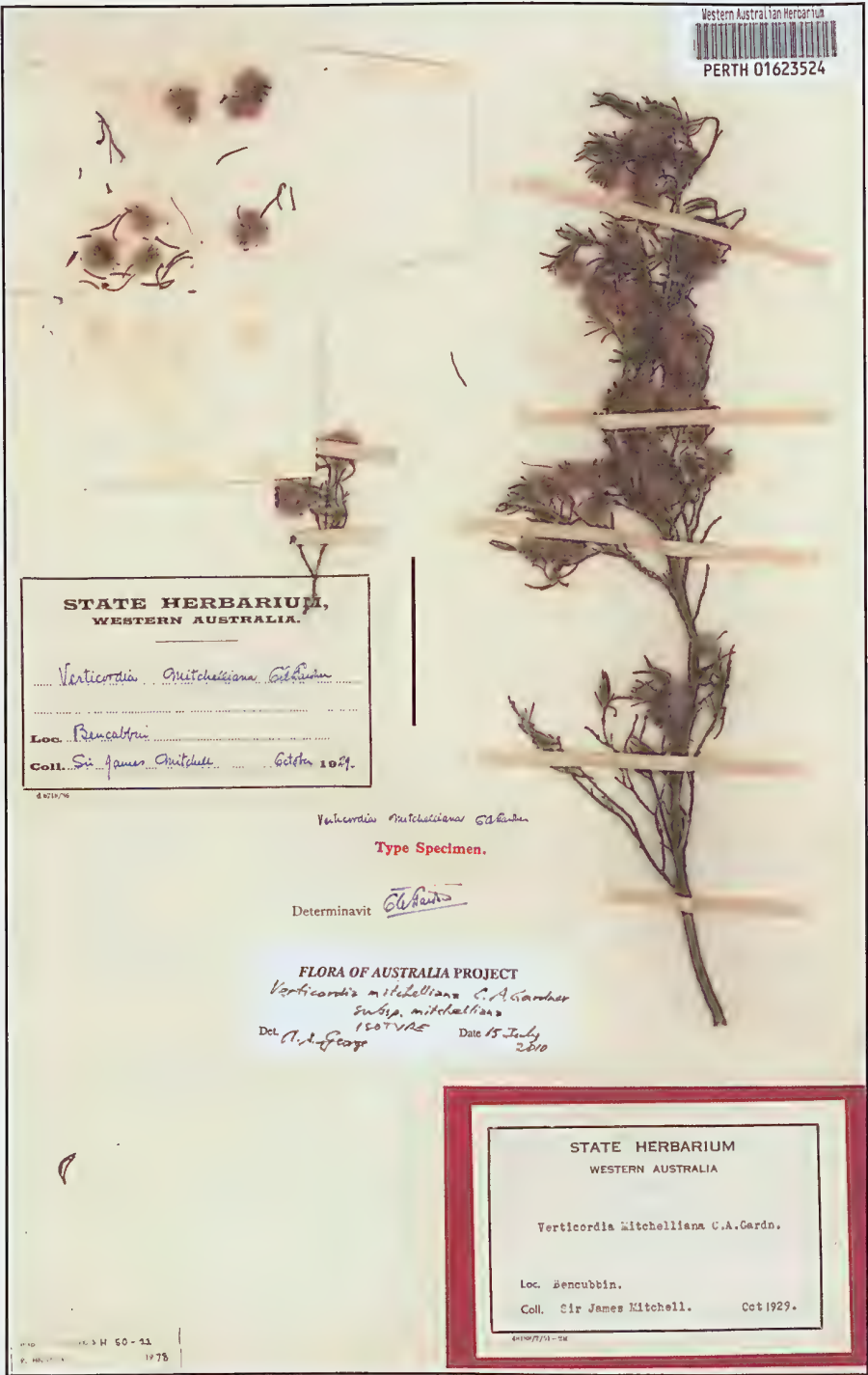


Figure 1. *Verticordia mitchelliana* subsp. *mitchelliana*. Isotype, near Bencubbin, October 1929, James Mitchell s.n. (PERTH 01623524). Scale bar = 5 cm.

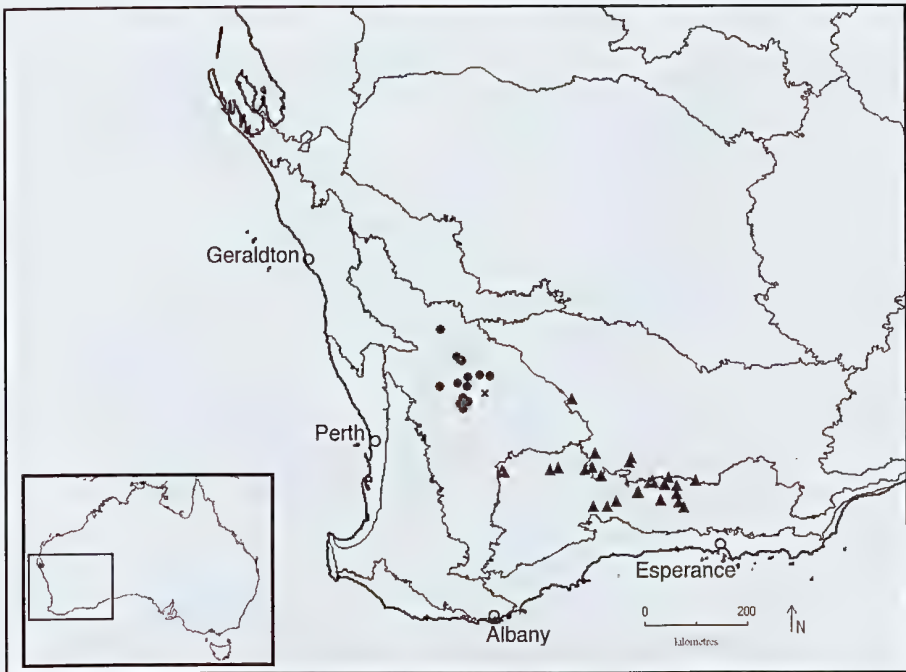


Figure 2. Distribution of *Verticordia mitchelliana* subsp. *mitchelliana* (●) and *V. mitchelliana* subsp. *implexior* (▲) in south-western Australia. The collection by W. Stevens, discussed below, is marked ×.

**Conservation status.** Well represented in conservation reserves and not considered threatened.

**Etymology.** The Latin *implexior* (more tangled) refers to the more copious divisions of the sepals compared to those of subsp. *mitchelliana*.

**Notes.** Compared with subsp. *mitchelliana*, the leaves are wider, the sepals and their auricles are more densely divided, the petals are longer and usually not or less fringed on the lateral margins, the staminodes are longer and slightly narrower, and the ‘neck’ of the style is usually shorter. In George and Pieroni (2002), the painting on page 295 represents subsp. *implexior*.

A collection labelled Trayning, Oct. 1961, *W. Stevens* [*C.A. Gardner* 13572], PERTH (from Herbarium Gardnerianum, New Norcia), lies on the south-eastern edge of the distribution of subsp. *mitchelliana* and is intermediate between the subspecies morphologically. It has leaves *c.* 1 mm wide, petals 8.5 mm long that are less pubescent outside and sparsely fringed along the lateral margins, and a style neck *c.* 1 mm long.

***Verticordia setacea* A.S. George, *sp. nov.***

*Ad Verticordiam gracilem* A.S. George affinis, a qua turmis florum spiciformibus vel racemiformibus, pedunculis brevioribus (1–3 mm longis, raro ad 5 mm), petalis dentatis vel ciliatis, et stylo breviori (1–1.5 mm longo), praecipue differt.

**Typus:** private land, north-east of Lake Grace, Western Australia, 15 Dec. 2000, *M. & J. Stewart* 69 (*holo*: PERTH 06843956).





Figure 3. *Verticordia mitchelliana* subsp. *implexior*. Holotype, 25 km east of Rabbit Fence (No. 2), between Hyden and Pioneer, C.A. Gardner 15010 (PERTH 02359340). Scale bar = 5 cm.

A shrub to 60 cm, without? lignotuber. *Stem leaves*  $\pm$  oblong, semiterete to triquetrous, obtuse, 4–7 mm long; floral leaves similar. *Flowers* spreading, in open, raceme-like or spike-like groups; scent not recorded. *Peduncles* 1–3 mm long, rarely to 5 mm. *Bracteoles* not keeled, not cuspidate, caducous. *Hypanthium* broadly turbinate, swollen at apex, 1.5–2 mm long, 10-ribbed,  $\pm$  verrucose, openly hirsute on ribs, and openly long-hirsute towards base. *Sepals* 3–4 mm long, spreading, deep pink, deeply fimbriate without definite lobes, scabrid; lamina setose inside; auricles absent or a few reflexed cilia. *Petals* 2–2.5 mm long, orbicular, erect with incurved apex, irregularly ciliate to dentate, more deeply towards base, the cilia and teeth themselves scabrid to minutely ciliate, scabrid outside, deep pink. *Stamens and staminodes* very shortly united; stamens  $\pm$  uniform, inflexed, 0.5–0.8 mm long; filaments terete, smooth, glabrous; anthers globular but compressed, 0.3–0.4 mm long; appendage absent. *Staminodes* erect, narrowly triangular, almost acute, 0.5–0.7 mm long, glandular-verrucose. *Style* 1–1.5(c. 4) mm long, straight, towards apex comosely bearded all round with simple hairs; stigma not enlarged. *Ovules* 2. (Figure 4)

*Selected specimens examined.* WESTERN AUSTRALIA: [localities withheld for conservation reasons] 21 Nov. 1980, D. Bell 17 (PERTH); 15 Nov. 1991, A.M. Coates 3487 (CANB, PERTH); 23 Dec. 2001, M. & J. Stewart 72 (PERTH).

*Distribution and habitat.* Occurs in a small area north-east of Lake Grace. Grows in lateritic soil or sand over laterite, in kwongan (Figure 5).

*Phenology.* Flowers November to December.

*Conservation status.* Conservation Codes for Western Australian Flora: recently listed as Priority Two. Known from several populations over a range of c. 40 km. Two are in a conservation reserve and one of these is reported to have c. 3000 plants. The record by D. Bell from ‘east of Hyden’ should be checked in the field – if confirmed, it would extend the range significantly.

*Etymology.* The Latin *setaceus* (setaceous) refers to the bristly aspect of the flowers due to the divisions of the sepals and petals and their setose to scabrid surface, especially the inner surface of the lamina of the sepals.

*Affinities.* Morphologically, *Verticordia setacea* is closely related to *V. gracilis* A.S. George (previously the only species in sect. *Platandra*) but differs in a more openly branched habit, the flowers arranged in raceme- or spike-like groups, the short peduncles, petals with dentate to ciliate margins and shorter style. The hairs on the hypanthium and at its base are less crowded. The species occurs to the south-west of *V. gracilis*. Recent collections of *V. gracilis* show that the hairs of the style are more commonly simple than divided. The specimen of D. Bell matches the others of *V. setacea* but has a style c. 4 mm long. The morphology of *V. setacea* necessitates amendments to the description of sect. *Platandra*: flowers in subcorymb-, raceme- or spike-like groups; style not or shortly exerted, bearded with forked or simple hairs. The setose inner face of the lamina of the sepals occurs in these two species and in *V. humilis* Benth.

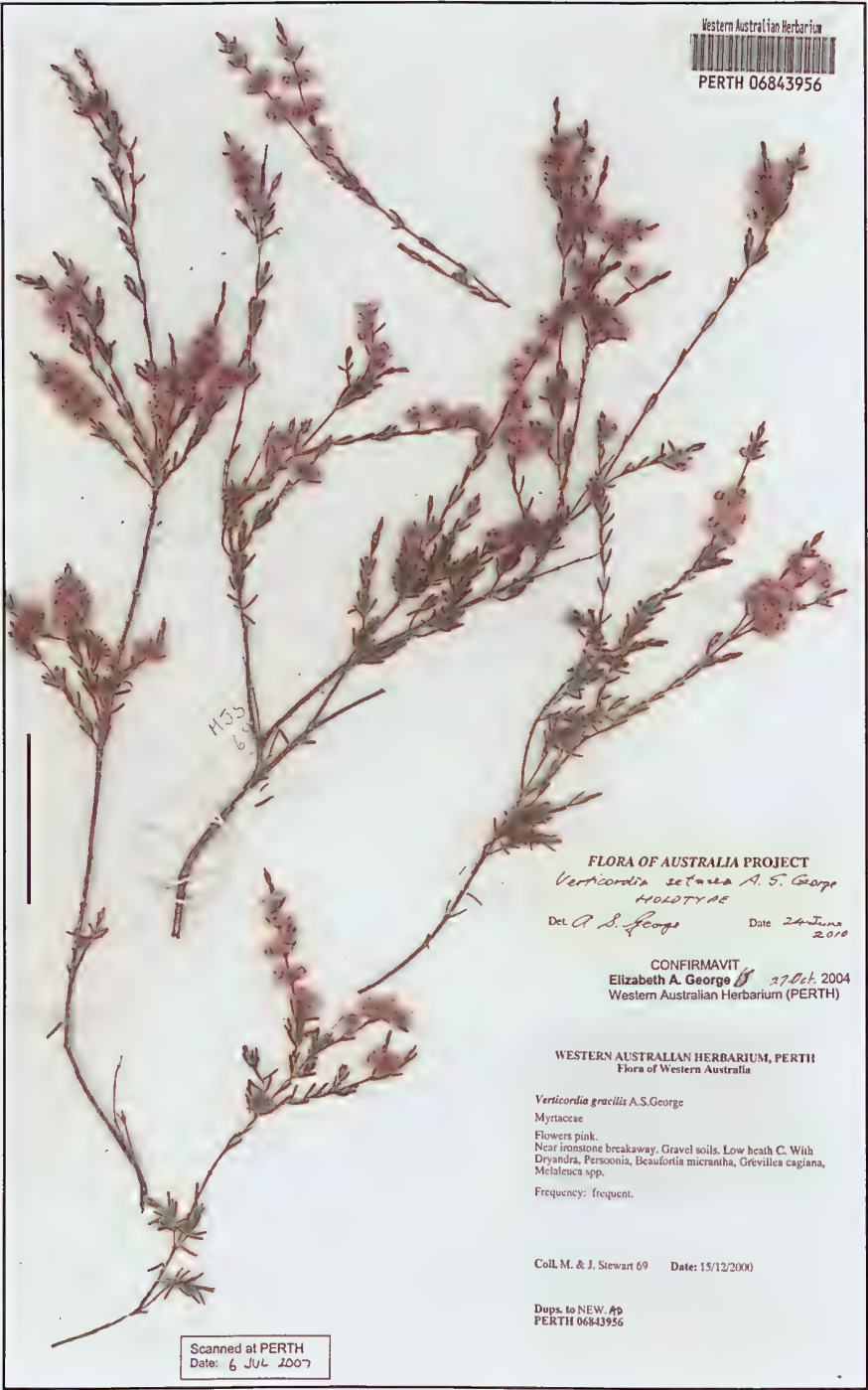


Figure 4. *Verticordia setacea*. Holotype, north-east of Lake Gracc, M. & J. Stewart 69 (PERTH 06843956). Scale bar = 5 cm.



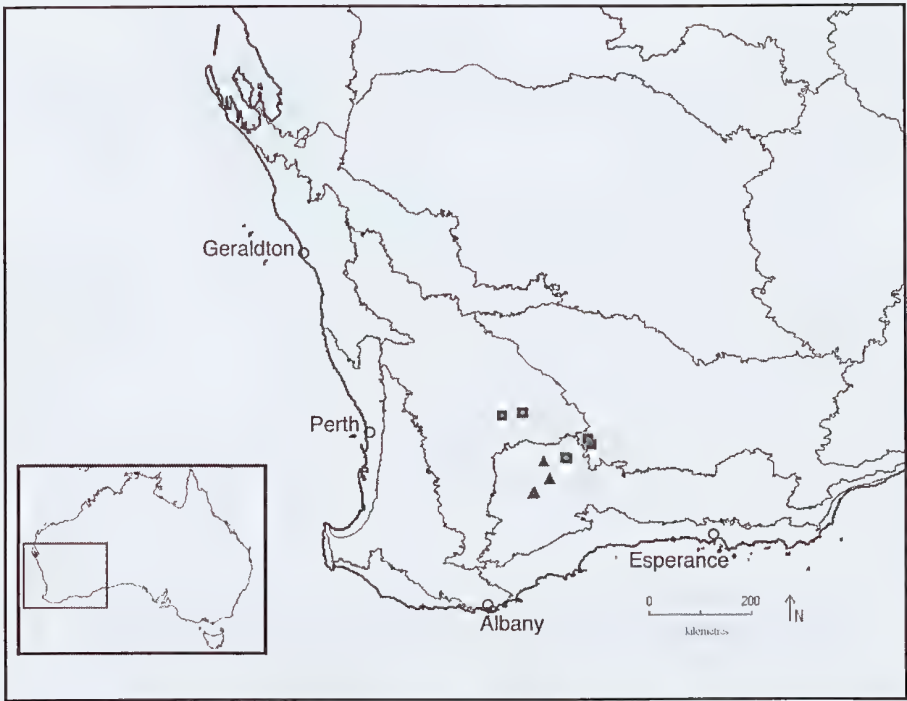


Figure 5. Distribution of *Verticordia setacea* (▲) and *V. gracilis* (■) in south-western Australia.

In the key to species in George and Pieroni (2002), *V. setacea* keys out to lead 43, *V. gracilis*, and may then be distinguished thus:

- 43a. Flowers in corymb-like groups; peduncles 9–12 mm long; petals erose to dentate and shortly fimbriate on lower margins; style c. 4 mm long..... ***V. gracilis***
- 43b. Flowers in raceme- or spike-like groups; peduncles 1–3 mm long, rarely to 5 mm; petals with dentate to ciliate margins; style 1–1.5(c. 4) mm long..... ***V. setacea***

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## SHORT COMMUNICATIONS

***Tetratheca* sp. Mt Solus (F. Obbens 307/98) (Elaeocarpaceae) is not distinct from *Tetratheca affinis***

*Tetratheca affinis* Endl. (*sensu* Thompson 1976) is a distinctive member of the genus, characterised among the Western Australian species by its combination of alate stems with narrowly triangular scale-leaves, 4- or 5-merous flowers, the apex of the peduncle expanding into a broad, conical receptacle with the calyx segments inserted well inside the receptacle rim, stamens with a distinct constriction between the hairy anther body and the glabrous anther tube, short glandular hairs on the ovary and multiple ovules (four or five) per loculus. Based on specimens at the Western Australian Herbarium (PERTH), its distribution in the South-West Botanical Province is from Balingup to Cape Riche, with two outlying collections from Yallingup (*Dr Ostenfeld* B.1141, *Miss Wood* 1596) made in October 1914.

*Tetratheca* sp. Mt Solus (F. Obbens 307/98) was collected in 1998 from Mt Solus, c. 65 km south-east of Perth, and was determined to be different from *T. affinis* based on the presence of only one ovule per loculus and its disjunct distribution (F. Obbens, pers. comm.). The name was placed on the Census of Western Australian Plants in 2000. The sole collection of *Tetratheca* sp. Mt Solus (F. Obbens 307/98) was made opportunistically during a recreational bush walk and repeated attempts to relocate the taxon by F. Obbens, T.D. Macfarlane and R. Butcher in recent years have been unsuccessful.

Examination of the *T. affinis* collection at PERTH against *Tetratheca* sp. Mt Solus (F. Obbens 307/98) has determined that ovule number per loculus is more variable than recognised by Thompson (1976), with some specimens having flowers with only one ovule per loculus (*R. Butcher* RB 945, *T.D. Macfarlane* TDM 1832, *E.M. Sandiford* EMS 871A, EMS 871B), one or two ovules per loculus (*W. Greuter* 23154), two ovules per loculus (*C. Andrews* s.n. PERTH 02961539), two or three ovules per loculus (*E.J. Croxford* 2131) and three ovules per loculus (*G.J. Keighery* 9658, *A.S. George* 176162, *K.R. Newbey* s.n. PERTH 06266630, *Col. Goadby* B.2566). Although ovule number is usually diagnostic for species of *Tetratheca* (Thompson 1976), intraspecific variation was recently observed in *T. aphylla* F.Muell., which was found to have one, rarely two, ovules per loculus (Butcher 2007).

All other morphological features of *Tetratheca* sp. Mt Solus (F. Obbens 307/98) fall within the range of variation observed for *T. affinis*. Specifically, *Tetratheca* sp. Mt Solus (F. Obbens 307/98) has slender, winged stems (1–2 mm wide), small flowers (petals 5.7–7.5 mm long, stamens 3.5–4.4 mm long), short hairs on the anther body and slightly curved anther tubes. These features are comparable to *T. affinis* which has stems 0.5–70 mm wide, petals 5.8–15 mm long and stamens 3.3–6 mm long. Co-occurring small- and large-flowered plants of *T. affinis* were observed near the Perup Forest Ecology Centre in 2008. Variation in stamen morphology includes specimens with anther tubes that are strongly sinuate (*R.D. Royce* 3134, *A. Burchall* 438), scarcely sinuate (*Ostenfeld* 1096), very slender (*R.J. Chinnock* 3242) and relatively thick (*A.S. George* 17162), as well as specimens with long (*C.P. Dornan* 509, *P.G. Wilson* 6340) or short hairs (*R.D. Royce* 3134) on the anther body and with additional, sparse, glandular hairs (*A.B. Cashmore* 76). The relative length of the anther tube to the anther body also displays some variation between specimens.



Given the variation observed within *T. affinis* and the absence of any unique morphological features in *Tetratheca* sp. Mt Solus (F. Obbens 307/98), this latter name is hereby subsumed under *T. affinis*. The disjunction of c. 130 km between Mt Solus and the nearest known *T. affinis* collection (12 km SE of Noggerup, *P.A. Jurjevich* 1899) is difficult to explain, however this situation is not unique (e.g. c. 350 km disjunctions occur in *Sphaerolobium calcicola* R. Butcher and *S. hygrophilum* R. Butcher; Butcher & Chappill 2004). A disjunction of c. 90 km is already recognised between collections of *T. affinis* from near Yallingup and from near Balingup (*E.M. Sandiford* 554). Mt Solus may represent the northernmost naturally occurring population of this species and additional collections may yet be made in the intervening areas.

Ironically, three specimens (*T.D. Macfarlane* TDM 1832, *E.M. Sandiford* EMS 871A, EMS 871B) from two localities near Cape Riche tentatively identified as *T. affinis* may warrant recognition as a new taxon. These specimens differ from typical *T. affinis* in having a smaller stature, consistently 4-merous flowers, a narrow receptacle which is formed at the apex of a gradually tapering peduncle, glabrous dorsal and lateral surfaces to the anther body, minute tubercles on the lower half of the sinuate anther tube and one ovule per locule, this attached near the apex of the septum by a small placenta. The two known localities of this entity are c. 50 km south-west of the nearest known population of typical *T. affinis* (Bluff Knoll Road, Stirling Range National Park, *J.J. Alford* s.n. PERTH 05979897) and c. 5.5 km apart from one another. Further field investigation in the Stirling Range–Albany–Cape Riche area is required to confirm the distinctness of this entity from *T. affinis*. The phrase name *T. affinis* subsp. Cape Riche (*T.D. Macfarlane* TDM 1832) has been erected on the Census (see Western Australian Herbarium 1998–) to refer to these specimens, pending their taxonomic resolution.

### Acknowledgements

This research was funded under a specific nature conservation project grant (2009–2010) within the Nature Conservation Service (formerly labelled as BCI).

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## A nomenclatural correction in *Verreauxia* (Goodeniaceae)

Roger Carolin (1992: 300) used the name *Verreauxia villosa* E.Pritz. for a rather rare species of this small Western Australian genus. He cited *Verreauxia dyeri* E.Pritz. ex Hemsl. as a synonym. The name *V. villosa* is current on *FloraBase* (Western Australian Herbarium 1998–). In 2005, when checking the holdings of this species at Kew for imaging early Australian collections for the Global Biodiversity Information Facility/Australian Virtual Herbarium project, I found that the second of these names seems to be correct as its publication predates that of the former by just a few weeks. A typographical error in a date of publication apparently led to the previous interpretation. The publication and typification details are as follows.

***Verreauxia dyeri*** E.Pritz. ex Hemsl., *Hooker's Icon. Pl.* ser. 4, 8: t. 2782 (Jan. 1905).

*Type citation*: 'WEST AUSTRALIA : Waranzering, Helms. ; Marmion, eighteen miles south of Menzies, L. Diels, 5191; railway between Cunderdin and Dedari, G. H. Thistleton-Dyer.'

All three collections are represented in the Herbarium of the Royal Botanic Gardens, Kew (K). Carolin (1992: 334) lectotypified the name on the collection by Thistleton-Dyer. The locality Waranzering (Helms) is a misprint of Warangering.

***Verreauxia villosa*** E.Pritz., *Bot. Jahr. Syst.* 35(4): 573 (14 Feb. 1905 – see below for discussion of date).

*Type citation*: 'in distr. Austin meridionali pr. Menzies, in arenosis apertis flor. m. Oct. (D. 5191).' [i.e. in the southern Austin district near Menzies, in open sandy areas flowering in October (*L. Diels* 5191)] (*holo*: K).

At Kew there is material of Diels' collection consisting of two leaves and portions of several inflorescences with the annotations: '5191 L. Diels Marmion 25 km südlich von Menzies Lichte Geholze auf Sand', ('375 m. ü M. Oct. 1901', 'Blüten gelb'). There is a determinavit slip by Pritzel: 'Verreauxia (without a number) was collected at Menzies (North Coolgardie) by L. Diels and described as *V. villosa* by myself. I change the name in Verreauxia Dyeri n. sp. Det. E. Pritzel'. The slip is undated but was possibly included with the specimen referred to in the letter below, i.e. written in early March 1904. It mentions Pritzel's proposal to alter the specific epithet from *villosa* to *dyeri*. It is unclear why Pritzel wrote that there was no number. Attached to the sheet is the following handwritten letter, written from Gr. Lichterfolde, 15 March 1904:

Dear Sir

our only specimen of *Verreauxia Dyeri* has been sent to you, a few days ago, for figuring. The hairs on the calyx seem to be more copious in our specimen than in the sketch you sent us some time ago, and the style is more slender. Herewith I am sending also the description. The only real distinct difference from *V. Reinwardtii* consists in the tomentum.

I am, sincerely yours,

Ernst Pritzel

Since Pritzel stated that the material sent to Kew was their (Berlin's) only specimen, I regard it as the holotype of the name *V. villosa*, while also being a syntype of *V. dyeri*. Carolin annotated it thus: 'Part of the HOLOTYPE of *V. villosa* E.Pritzel LECTOTYPE of *V. dyeri* E.Pritzel ex Hemsl. Determinavit R.Carolin 26.9.1962', although in his *Flora of Australia* account of *V. villosa* (Carolin 1992: 300), he stated 'holo: B? (destroyed) *n.v.*'

Although Pritzel wrote that he was changing the epithet from *villosa* to *dyeri*, it appears that either his description under the former epithet was already too far advanced in publication for him to alter it (even though it did not appear until the following February), or he simply forgot to alter his own manuscript. Oddly, in the introductory paragraph of the account of *Verreauxia* in the *Botanische Jahrbücher*, he cited both names but used *V. villosa* in the description.

The account with the epithet *dyeri* was published in *Hooker's Icones Plantarum* in January 1905, just weeks or maybe days before the account in *Botanische Jahrbücher*. Volume 35 of the *Botanische Jahrbücher* was published in five parts (Hefen). Each Heft has the year of publication and a precise date printed on the title page. These dates are 1904 and 15 April 1904 for Heft 1, 1904 and 6 Dec. 1904 for Heften 2 and 3 (published together), 1905 and 14 Feb. 1904 for Heft 4, and 1905 and 18 April 1905 for Heft 5. From this it is clear that '1904' in Heft 4 is a typographical error. In the copy at Kew the '4' of '1904' has been crossed out and '5' pencilled in. The third supplement of *Index Kewensis* in which both names were listed gave no dates of publication. The year 1904 was accepted by later workers in Australia (e.g. Gardner 1931), who therefore considered Pritzel's name *V. villosa* the earlier one. The corrected date is cited in Stafleu and Cowan (1976) and in the entry for *V. villosa* in Chapman (1991), but it was not picked up when the account was being prepared for the *Flora of Australia*. It seems clear that this date should be accepted, which makes the publication of the relevant part of *Hooker's Icones Plantarum* earlier by just a few weeks, and so the name *Verreauxia dyeri* has priority.

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## A lectotype and new combination in *Hypocalymma* (Myrtaceae: Chamelaucieae)

*Hypocalymma* (Endl.) Endl. was first described as a section of *Leptospermum* J.R.Forst. & G.Forst. (Endlicher 1837) and shortly afterwards raised to the generic level (Endlicher 1840). It was based on the two species now known as *H. angustifolium* (Endl.) Schauer and *H. robustum* (Endl.) Lindl. In their recent review of the genus, Strid and Keighery (2002) recorded *H. angustifolium* as the type species, but they did not lectotypify it nor refer to any previous lectotypification. As *H. robustum* appears to be a better match for the protologue, that species is selected here as the lectotype.

Strid and Keighery (2002) greatly increased the number of named taxa in *Hypocalymma* by describing nine new species and two new subspecies. It is now evident that one of their new subspecies, *H. strictum* subsp. *elongatum* Strid & Keighery, is more distinctive than previously thought as it differs from *H. strictum* Schauer subsp. *strictum* in its ovule number. Both taxa have a two-locular ovary but whereas subsp. *strictum* has three ovules per loculus, subsp. *elongatum* has only one ovule per loculus. A new combination is made to raise subsp. *elongatum* to the species level and a key to all members of the genus with a two-locular ovary is provided to assist with their identification. The description of this taxon was prepared from herbarium specimens, with all measurements recorded from well pressed, fully mature organs.

### Lectotypification and new combination

**Hypocalymma** (Endl.) Endl., *Gen. Pl.* 16, 1230 (1840). – *Leptospermum* sect. *Hypocalymma* Endl., *Enum. Pl. Nov. Holl.* 50 (1837). – *Baeckea* sect. *Hypocalymma* (Endl.) Baillon, *Hist. Pl.* 6, 358 (1876). Type: *Leptospermum robustum* Endl. [= *Hypocalymma robustum* (Endl.) Lindl.], lectotype, here chosen.

*Notes.* As explained above, one of the two species listed by Endlicher (1837) needs to be chosen as the lectotype for *Hypocalymma*. On morphological grounds the second species, *H. robustum*, would seem to be a better choice as the characters given by Endlicher (1837: 50, footnote) to separate his new group from the typical section of *Leptospermum* were ‘ovario 2loculari (?) staminibus subexertis, et foliis oppositis’. *Hypocalymma robustum* matches this description in all respects, whereas *H. angustifolium* differs in having a three-locular ovary.

The decision to designate *Hypocalymma robustum* as the type of the genus is also in agreement with Schauer (1844). In his sectional classification, he placed *H. robustum* in *H.* sect. *Eucalymma* Schauer together with several species characterized by two 3-ovulate loculi, whereas *H. angustifolium* was placed in sect. *Astrocalymma* Schauer along with another species with three 1-ovulate loculi. At that time, the prefix *Eu* was generally applied to the taxonomic group considered to be the true or original part of the genus, although it was the usual practice to attach the prefix to the full generic name. All such names are invalid according to the current code of nomenclature (Art. 21.3, McNeil *et al.* 2006), although it is not clear whether this article applies to sect. *Eucalymma* since it omits the first part (*hypo*-) of the generic name. Either way, sect. *Eucalymma* must now be known as sect. *Hypocalymma* since the name of a subdivision of a genus that includes the type must repeat the generic name unaltered (Art. 22.2, McNeil *et al.* 2006).

**Hypocalymma elongatum** (Strid & Keighery) Rye, *comb. et stat. nov.*

*Hypocalymma strictum* subsp. *elongatum* Strid & Keighery, *Nord. J. Bot.* 22: 560–561 (2002). *Type*: 1.5 km north-east of Wellstead along highway to Jerramungup, Western Australia, 16 March 1983, A. Strid 22469 (*holo*: PERTH 01945114; *iso*: B, C, G, K, MEL, MO, P all *n.v.*).

*Shrub* 0.3–1.6 m high, one record describing it as erect, compact and with a rounded canopy. *Young stems* glabrous, 4-angled, with well spaced leaves, with most of the lower internodes on each branchlet 6–12 mm long. *Petioles* more or less absent. *Leaf blades* linear or long-linear in outline, 20–32 mm long, 0.5–1 mm wide, 0.5–0.9 mm thick, concolorous, glabrous, entire; apical point 0.4–1 mm long. *Peduncles* 1–1.5 mm long, all or mostly 2-flowered. *Secondary peduncles* 0.1–0.3 mm long. *Bracts and bracteoles* caducous or deciduous, commonly 1.2–3 mm long, acute or acuminate. *Pedicels* 0–0.5 mm long. *Flowers* 8–9 mm diam.; floral tube 1.1–1.4 mm long, rugose-pitted. *Sepals* 1.1–1.5 mm long, obtuse, with a somewhat herbaceous base and a broad scarious margin; herbaceous base dotted with oil glands. *Petals* 3–3.5 mm long, pink, not persistent in fruit. *Stamens* approximately 35–55 in 2 series, united at base for 0.5–0.9 mm. *Ovary* 2-locular; ovules 1 per loculus, erect. *Style* 4.6–5.2 mm long; base not in a depression. *Fruit* half or over half superior, compressed, *c.* 3 mm long, *c.* 3.5 mm wide, *c.* 2.5 mm deep. *Seeds* more or less reniform including a large inner protrusion, 1.6–1.7 mm long; testa brown, pitted; inner protrusion pale, with a bubbly appearance.

*Selected specimens examined.* WESTERNAUSTRALIA: [precise localities withheld for conservation reasons] Wellstead area, 17 Nov. 1979, *E.J. Croxford* 677 (PERTH); E of Manypeaks, 27 May 1964, *A.S. George* 6263 (PERTH); Hamilla Hill Nature Reserve, 17 Apr. 2003, *M. Hislop* 2924 (PERTH); Wellstead area, 16 Nov. 1985, *J.M. Powell* 3276 & *M. Hardie* (PERTH); 10 miles [16 km] S of Ellen Peak 1 May 1966, *K.R. Newbey* 2432 (PERTH); Kojaneerup West Rd, NE of Albany, 27 Feb. 1982, *M. Sherwood* 627 (PERTH); W of South Talyuberlup Track, 20 March 1989, *R.T. Wills* 972 (PERTH).

*Distribution and habitat.* Occurs in the region surrounding Stirling Range, from Hamilla Hill Nature Reserve east to Wellstead, in the south-west of Western Australia. Recorded in sandy soils, sometimes overlying laterite, commonly with *Banksia* and/or *Eucalyptus*.

*Phenology.* Flowers mainly from March to May, also recorded from October to November.

*Conservation status.* Recently listed as Priority Three under the Department of Environment and Conservation's Conservation Codes for Western Australian Flora. This species is known from at least five localities over a range of about 90 km, including a nature reserve.

*Affinities.* Closely related to *Hypocalymma asperum* Schauer, *H. jessicae* Strid & Keighery and *H. strictum*, differing from all three species in its longer leaves, with a more prominent apical point 0.4–1 mm long, and tending to be a taller shrub. *Hypocalymma jessicae* occurs east of the range of *H. elongatum* in rocky habitats, and has more densely clustered leaves, usually with a distinct petiole 0.4–1.3 mm long. It usually has the same ovule number as *H. elongatum* but its leaves are usually thicker than they are wide whereas those of *H. elongatum* are usually wider than thick. The leaves of *H. elongatum* are also more acutely angled along the margins.

The other two species differ from *H. elongatum* in having three ovules per loculus. Both are predominantly summer-flowering, whereas *H. elongatum* appears to flower mainly in spring and autumn. These differences in flowering time may be important in maintaining the reproductive isolation of

*H. elongatum* and may greatly reduce the likelihood of its being collected simultaneously with one of the other species. The only clear record of coexistence comes from notes on a specimen (*M. Hislop* 2924) collected at Hamilla Hill, where *H. elongatum* was ‘growing in same area as *H. asperum* but with latter not flowering’.

*Hypocalymma asperum* overlaps markedly in its geographic range with each of the other three species but differs from all of them in having protruding oil glands, with radiating projections like a star, on its young stems and leaves. Differences in habitat preferences may also be important in this plant group, with *H. strictum* possibly rarely co-occurring with related species because of its greater tendency to occur in damp habitats.

*Notes.* Additional fruiting material is needed for *Hypocalymma elongatum* as mature seeds have only been recorded from the *J.M. Powell* 3276 & *M. Hardie* specimen. The species also needs to be surveyed to assess its conservation status.

Key to the species of *Hypocalymma* with a 2-locular ovary

- 1. Leaves 50–70 mm long. Petals white or cream. Ovules 8–11 per loculus. (Murchison River area)..... **H. longifolium**
- 1: Leaves 8–25 mm long. Petals pale to deep pink. Ovules 1–3 per loculus
- 2. Flowers solitary in the axils. Petals 9–13 mm long. Ovules and seeds horizontal. (Cockleshell Gully to Lake King) ..... **H. puniceum**
- 2: Flowers paired in all or most of the axils. Petals 3–5.5 mm long. Ovules and seeds erect
- 3. Ovules 1 per loculus
- 4. Shrub up to 1.6 m high; branchlets with well spaced, more or less sessile leaves. Largest leaves 20–32 mm long. (Eastern edge of Stirling Range and Wellstead)..... **H. elongatum**
- 4: Shrub 0.3–1 m high; branchlets with densely clustered leaves usually with a petiole 0.4–1.3 mm long. Largest leaves 7–15 mm long. (Ravensthorpe Range to Fitzgerald River National Park)..... **H. jessicae**
- 3: Ovules 2 or 3 per loculus
- 5. Leaves 15–30 mm long, 1.2–3 mm wide, distinctly wider than thick. Petals medium to deep pink, 4–5.5 mm long. (Moore River to Walpole)..... **H. robustum**
- 5: Leaves 3–20(–25) mm long, 0.6–1 mm wide, very thick. Petals pale to medium pink, 3–4 mm long
- 6. Young stems glabrous. Leaves 6–25 mm long, glabrous
- 7. Leaves densely clustered on the branchlets, usually with a petiole 0.4–1.3 mm long. Peduncles 1–1.5 mm long. (Ravensthorpe Range to Fitzgerald River National Park).... **H. jessicae**
- 7: Leaves not densely clustered on the branchlets, more or less sessile. Peduncles up to 1 mm long. (Augusta to Ravensthorpe Range and Hopetoun)..... **H. strictum**
- 6: Young stems with star-like protruding oil glands. Leaves 3–9(–13) mm long, with stellate protrusions like those on the stems. (Lake Grace to Stirling Range to Cape Arid) ..... **H. asperum**



### Acknowledgements

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Referees for Volume 20

The assistance of referees in providing expert review of papers submitted to *Nuytsia* is gratefully acknowledged. The referees consulted for Volume 20 include those listed below. Each paper was also refereed internally by *Nuytsia* Editorial Committee members.

Tony Bean	Barbara Rye
Elaine Davison	Philip Short
Neil Gibson	Neil Snow
Peter Jobson	Roger Spencer
Brendan Lepschi	Kevin Thiele
Peter Linder	Carol Wilkins
Terry Macfarlane	Paul Wilson
Jo Palmer	Peter Wilson
Chris Quinn	

Corrections

Volume 19(2)

Following Craven (2002), one couplet of the key on page 317 needs to be corrected to:

- 19. Leaves opposite. Ovules 2 per loculus, one on each side of the placenta, laterally or laterally-basally attached .....**Conothamnus**
- 19: Leaves alternate or rarely opposite. Ovules more than 2, up to 230 per loculus, irregularly arranged all over the placenta, basally attached .....**Melaleuca**

Craven, L.A. (2002). Notes on *Conothamnus* Lindl. with the description of a new section, sect. *Gongylocephalus* Craven (Myrtaceae). *Muelleria* 16: 39–42.

### CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

- R:** Declared Rare Flora – Extant Taxa (= Threatened Flora= Endangered+ Vulnerable) Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.
- X:** Declared Rare Flora - Presumed Extinct Taxa Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for Environment, after recommendation by the State's threatened Species Scientific Committee.
- 1:** Priority One – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- 2:** Priority Two – Poorly Known Taxa Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- 3:** Priority Three – Poorly Known Taxa Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
- 4:** Priority Four – Rare Taxa Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.



## NOTES FOR AUTHORS

*Nuytsia* publishes original papers and short communications on systematics, taxonomy and nomenclature of Australian (particularly Western Australian) plants, algae and fungi, with preference given to papers dealing with new taxa, revisions, systematic analyses and classifications, censuses, invasive species, and nomenclatural and taxonomic issues. Book reviews will not be accepted. All papers are peer reviewed and should not be under consideration elsewhere. No page charges apply.

Authors should read and follow the comprehensive guidelines for authors available at <http://science.dec.wa.gov.au/nuytsia>, paying particular attention to the following:

**Manuscript format.** Double-sided with 1.5-line spacing throughout. All text should be in the typeface (bold, italic etc.) in which it will be published. Manuscripts may be submitted by email, in MS-Word format.

**Title.** Should be concise and include the family name of genera or species treated (but not authorities) and geographic scope where appropriate. New taxa should be named if not numerous. Full author's names should follow the title, followed by institutional addresses keyed by superscripted letters. An email address should be given for the Corresponding Author, if possible.

**Abstract.** Must comprise a single paragraph and provide a stand-alone summary of the paper for abstracting services. All new names and combinations made in the paper should be listed if possible.

**Names.** Nomenclatural authorities must be provided for first instances of all taxonomic names below the rank of family, both in the Abstract and in the body of the text.

**Headings.** Principal headings should be bold and centred; second-order headings should be italicized, left-justified and separated from the following text by a stop without paragraph break.

**Keys.** May be either indented (e.g. *Nuytsia* 18: 45) or bracketed (e.g. *Nuytsia* 18: 149). Indented keys involving more than nine levels of indentation should be avoided.

**Conservation status.** Conservation Codes as used by the Department of Environment and Conservation should be recommended for rare and threatened taxa; these will be assessed by Department staff during review of the paper. Precise localities and georeferences should not be given for Declared Rare and Priority taxa; instead, cite generalized localities only, accompanied by the statement "[Precise localities withheld for conservation reasons]".

**Abbreviations.** The following standards are used for abbreviations:

- Nomenclatural authors: *Authors of Plant Names* (Brummitt & Powell 1992).
- Bibliographic references (nomenclatural sections only): *Taxonomic Literature II* (Stafleu & Cowan 1976–1986; Stafleu & Mennega 1992–) for books; *Botanico-Periodicum-Huntianum* (Lawrence *et al.* 1968) for journals.
- Herbaria: *Index Herbariorum* (Holmgren *et al.* 1990).

**References.** Citations in the text should be of the form *Author's Surname(s) (year) [or (year: page)]* with full details given in the Reference section. Use an ampersand to separate two authors, and *First Author et al.* for three or more authors. Citations in the References section should be of the forms:

- *Journal article:* Butcher, R. (2007). New 'leafless' *Tetratheca* (Elaeocarpaceae, formerly Tremandraceae) taxa from Western Australia. *Australian Systematic Botany* 20(2): 139–160.
- *Book:* Paczkowska, G. & Chapman, A.R. (2000). *The Western Australian flora: a descriptive catalogue*. (Wildflower Society of Western Australia: Nedlands, WA.)
- *Chapter in a book:* Rye, B.L. (1992). Myrtaceae. In: Wheeler, J.R. (ed.) *Flora of the Kimberley Region*. pp. 499–546. (Western Australian Herbarium: Perth.)
- *Website:* Western Australian Herbarium (1998–). *FloraBase – The Western Australian flora*. Department of Environment and Conservation. <http://florabase.dec.wa.gov.au/> [accessed May 2008]

**Images.** Images may be embedded in the body of the paper for submission and review; image resolution and quality should be sufficient but not excessive, to allow the complete manuscript to be emailed. After final acceptance of the paper, images must be supplied as separate files and removed from the body of the text. Instructions regarding formats, resolution etc will be sent with the review letter.

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The status of infraspecific taxa and new subspecies in <i>Ptilotus stirlingii</i> (Amaranthaceae). R.W. Davis and R. Butcher	261
<i>Logania sylvicola</i> (Loganiaceae), a new species from south-west Western Australia. R.J. Cranfield, M. Hislop and T.D. Macfarlane	271
<i>Darwinia hortiorum</i> (Myrtaceae: Chamelaucieae), a new species from the Darling Range, Western Australia. K.R. Thiele	277
Myxomycota census of Western Australia. K.J. Knight and M.H. Brims	283
Two new taxa of <i>Verticordia</i> (Myrtaceae: Chamelaucieae) from south-western Australia. A.S. George and M.D. Barrett	309
<b>Short communications</b>	
<i>Tetratheca</i> sp. Mt Solus (F. Obbens 307/98) (Elaeocarpaceae) is not distinct from <i>Tetratheca affinis</i> . R. Butcher	319
A nomenclatural correction in <i>Verreauxia</i> (Goodeniaceae). A.S. George	321
A lectotype and new combination in <i>Hypocalymma</i> (Myrtaceae: Chamelaucieae). B.L. Rye	323
<b>Other contents</b>	
Referees for Volume 20	327
Corrections to <i>Nuytsia</i> Volume 19(2)	327
Conservation Codes for Western Australian Flora	328
Publication date for <i>Nuytsia</i> Volume 19(2)	328
Notes for authors	329



# CONTENTS

## Main papers

- Typification of *Gnaphalium collinum* var. *monocephalum* (Gnaphalieae: Asteraceae) and clarification of related material. C. Flann, P.G. Wilson and J.J. Wierenga 1
- Molecular markers provide an independent test of species boundaries in the two morphologically similar species *Desmocladus flexuosus* and *D. asper* (Restionaceae). E.A. Sinclair and R.L. Barrett 7
- A new locally endemic species of *Acrotriche* (Ericaceae: Styphelioideae: Styphelieae) from the Ravensthorpe area. M. Hislop 19
- Melaleuca* (Myrtaceae) of Western Australia: five new species, three new combinations, one new name and a new state record. L.A. Craven, B.J. Lepschi and K.J. Cowley 27
- A revision of the *Micromyrtus racemosa* complex (Myrtaceae: Chamelaucieae) of south-western Australia. B.L. Rye 37
- A revision of *Calothamnus quadrifidus* (Myrtaceae). A.S. George and N. Gibson 57
- Stylidium* miscellany 1: typifications and new taxa from south-west Western Australia. J.A. Wege 79
- An account of *Eutaxia* (Leguminosae: Mirbelieae) with a focus on the Western Australian species. C.F. Wilkins, J.A. Chappill and G.R. Henderson 109
- Two new, glaucous-leaved species of *Isopogon* (Proteaceae: Proteoideae: Leucadendreae) from south-western Australia. M. Hislop and B.L. Rye 169
- Calothamnus* (Myrtaceae): precursor paper to *Flora of Australia*. A.S. George 183
- A taxonomic revision of the Western Australian endemic species *Kennedia coccinea* (Fabaceae). T.R. Lally 201
- Re-evaluation of *Ptilotus polystachyus* sens. lat. (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*. R.W. Davis and R. Butcher 217
- Enekbatus*, a new Western Australian genus of Myrtaceae with a multi-locular indehiscent fruit. M.E. Trudgen and B.L. Rye 229

CONTENTS (continued)

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